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Biology

CONTENTS.

PART I.

- ART. I.—Description of fifty-two Species of Unionidæ. By Isaac Lea, . . . 5
ART. II.—Supplement to Isaac Lea's paper on Unionidæ, . . . 55
ART. III.—On the Homologies and Origin of the Types of Molar Teeth of Mammalia Educabilia. By Edw. D. Cope, . . . 71

PART II.

- ART. IV.—On the Batrachia and Reptilia of Costa Rica. By E. D. Cope, . . . 93
ART. V.—On the Batrachia and Reptilia collected by Dr. John M. Bransford during the Nicaraguan Canal Survey of 1874. By E. D. Cope, . . . 155
ART. VI.—Report of the Reptiles brought by Prof. James Orton from the middle and upper Amazon and western Peru. By E. D. Cope, . . . 159
ART. VII.—Note on the Ichthyology of Lake Titicaca. By E. D. Cope, . . . 185
ART. VIII.—A descriptive Catalogue of the Scalidæ of the West India Islands. By O. A. L. Mörch, Ph.D., . . . 186

PART III.

- ART. IX.—Description of Vertebrate Remains, chiefly from the Phosphate Beds of South Carolina. By Prof. Jos. Leidy, . . . 209
ART. X.—Description of a Collection of Fossils made by Doctor Antonio Raimondi, in Peru. By Wm. M. Gabb, . . . 263

PART IV.

- ART. XI.—Description of Caribbean Miocene Fossils. By Wm. M. Gabb, . . . 337
ART. XII.—Descriptions of New Species of Fossils from the Pliocene Clay Beds between Limon and Moen, Costa Rica, together with Notes on previously known species from there and elsewhere in the Caribbean Area. By Wm. M. Gabb, . . . 349
ART. XIII.—The Terrestrial Mollusca inhabiting the Cook's or Harvey Islands. By Andrew Garrett, . . . 381
ART. XIV.—The Placenta and Generative Apparatus of the Elephant. By Henry C. Chapman, M.D., . . . 413
ART. XV.—The Parasites of the Termites. By Joseph Leidy, M.D., . . . 425
ART. XVI.—Remarks on *Bathynathus borealis*. By Joseph Leidy, M.D., . . . 449

Extra copies printed in advance for the authors.

ART. I.—*Description of fifty-two species of Unionidæ.*

By ISAAC LEA.

UNIO GLOBATUS. Pl. 1, fig. 1.

Testa lævi, globosa, valde inflata, valde inæquilaterali; valvulis crassis, antice crassioribus; natibus valde inflatis, parum elevatis; epidermide tenebroso-fusca; dentibus cardinalibus per crassis et valde corrugatis; lateralibus curtis, crassis, parum curvatis corrugatisque; margarita argentea et iridescente.

Shell smooth, globose, very much inflated, very inequilateral; valves thick, thicker before; beaks very much inflated, somewhat raised; epidermis dark brown; cardinal teeth very thick and very much corrugate; lateral teeth short, thick, somewhat curved and corrugate; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 191.

Hab.—Holston River, Dr. Edgar. Etowah River, Geo., Th. Bland.

My cabinet.

Diam. 1·2,

Length 1·6,

Breadth 1·8 inch.

Shell smooth, globose, very much inflated on the umbones, very inequilateral, rounded before and behind; substance of the shell very thick, thicker before; beaks somewhat raised and much inflated; ligament short, thick, and dark brown; epidermis dark brown, with close marks of growth; umbonial slope rounded; posterior slope cordate and with indistinct lines from the beaks to the margin; cardinal teeth very thick, very much sulcate and roughened, disposed to be treble in the right valve; lateral teeth short, thick and corrugated, and somewhat curved; anterior cicatrices distinct, rather small, and deeply impressed; posterior cicatrices distinct, rather small and well impressed; dorsal cicatrices placed on the under side of the cardinal teeth; cavity of the shell rather shallow and wide; cavity of the beaks rather deep and obtusely angular; nacre silver white and iridescent.

Remarks.—Many years since the late Dr. Edgar sent me two specimens from East Tennessee. I hesitated to consider it a distinct species until I received a third specimen from my friend Mr. Bland, who obtained it from a different habitat. It is a remarkable spherical species, and may be confounded with *subrotundus* on one side, and *subglobatus* herein described on the other. It is a much smaller species than the first, and more rounded than the latter. It need not be con-

founded with *sphæricus* (nobis), for that species is nodulous and has higher beaks. The three specimens before me differ very little. In the youngest there are a few indistinct rays near the termination of the beaks: none are exhibited on the others. All these specimens have eroded beaks, and therefore their character as to undulation cannot be ascertained.

UNIO VALIDUS. Pl. 1, fig. 2.

Testa lævi, triangulari, inflata, inæquilaterali, antice rotunda, postice obtuse angulata; valvulis crassis, antice aliquanto crassioribus; natibus prominentibus, ad apices undulatis; epidermide olivacea, valde radiata; dentibus cardinalibus crassis, compressis crenulatisque; lateralibus sublongis, crassis subcurvisque; margarita argentea et iridescente.

Shell smooth, triangular, inflated, inequilateral, round before, obtusely angular behind; valves thick, somewhat thicker before; beaks prominent, undulate at the tips; epidermis olive color and very radiate; cardinal teeth thick, compressed, and crenulate; lateral teeth rather long, thick and curved; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 189.

Hab.—Duck River, Tenn., Dr. Powell.

My cabinet.

Diam. 1,

Length 1·7,

Breadth 2·1 inches.

Shell smooth, triangular, inflated, inequilateral, round before and obtusely angular behind; substance of the shell thick, somewhat thicker before; beaks prominent and undulate at the tips; ligament rather long and dark brown; epidermis olivaceous, with numerous slightly interrupted rays over most of the disks, with distant lines of growth; umbonial slope obtusely angular; posterior slope elliptical, very slightly raised, with obscure rays; cardinal teeth very thick, compressed, crenulate, double in the left and disposed to be treble in the right valve; lateral teeth rather long, thick and disposed to be double in both valves; anterior cicatrices distinct, rather large and deeply impressed; posterior cicatrices distinct, well impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell rather deep and rounded; cavity of the beaks shallow and obtusely angular; nacre silver white and iridescent.

Remarks.—A full grown specimen received from Dr. Powell many years since. It perplexed me as to its specific value, and I was disposed to think it a variety of *Bigbyensis* (nobis), being very nearly of the same outline. It differs in being more inflated and in having an olive epidermis. It is a stouter shell and has thicker teeth. The tips of the beaks of the specimen before me are somewhat eroded, but here remains enough to display several minute subconcentric undulations.

UNIO SUBGLOBATUS. Pl. 1, fig. 3.

Testa lævi, suborbiculata, valde inflata, inæquilaterali; valvulis per crassis; natibus tumidis, elevatis, incurvis; epidermide tenebroso-fusca, ad apicem maculata et radiata; dentibus cardinalibus parvisculis, compressis sulcatisque; lateralibus crassis, curvatis corrugatisque; margarita argentea et iridescente.

Shell smooth, suborbicular, very much inflated, inequilateral; valves very thick; beaks swollen, elevated, incurved; epidermis dark brown, spotted and radiate towards the tips; cardinal teeth rather small, compressed and sulcate; lateral teeth thick, curved and corrugate; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 191.

Hab.—Florence, Ala., B. Pybas; Nashville, Tenn., Pres. J. B. Lindsley.

My cabinet.

Diam. 1·3,

Length 1·6,

Breadth 1·8 inch.

Shell smooth, orbicular, very much inflated, inequilateral; substance of the shell very thick, thicker before; beaks very much inflated, very prominent and incurved; ligament short, thick and dark brown; epidermis dark brown, maculate, rayed towards the beaks, and with rather close marks of growth; umbonial slope raised and rounded; posterior slope widely cordate and without rays; cardinal teeth rather small, deeply lobed, compressed, corrugate, and disposed to be treble in the left valve; lateral teeth thick, curved, abrupt at the end and corrugate; anterior cicatrices distinct, small and deeply impressed; posterior cicatrices distinct, rather small, and well impressed; dorsal cicatrices within the cavity of the shell and under the plate, which is very large; cavity of the shell rather deep and rounded; cavity of the beaks very shallow and rounded; nacre silver white and iridescent.

Remarks.—This is the most globose species with which I am acquainted except *capax*, Green, which is a very large and very different species. They cannot be at all compared except in the single character of globosity. I have three specimens before me, all of different ages. The oldest is much eroded at the beaks and umbones, and presents only a few maculations along the umbonial slope. The middle aged and young one have maculated rays and are slightly polished towards the tips. In outline it is allied to *ebenus*, *subrotundus*, and *pilaris* (nobis). It is more inflated than either. It is not so retuse in the beaks as *ebenus*, nor has it so dark an epidermis. It is a smaller species than *subrotundus*, and more inflated. It differs from *pilaris* in having a lighter epidermis, and in being more rotund. Neither of the specimens have beaks perfect enough to present undulations at the lips.

UNIO LAWII. Pl. 2, fig. 4.

Testa lævi, obliqua, clavæformi, antice tumida, valde inæquilaterali, postice obtuse angulata; valvulis crassis, antice aliquanto crassioribus; natibus prominentibus, fere terminalibus; epidermide plavida, radiis interruptis indutis; dentibus cardinalibus paviusculis, acuminatis crenulatisque; lateralibus sublongis, subcurvis lamellatisque; margarita argentea et iridescente.

Shell smooth, oblique, clubshaped, swollen before, very inequilateral, obtusely angular behind; valves thick, rather thicker before; beaks prominent, nearly terminal; epidermis yellowish, covered with interrupted rays; cardinal teeth rather small, acuminate and crenulate; lateral teeth rather long, somewhat curved and lamellar; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 189.

Hab.—Tennessee River, Tuscumbia, Ala., Mr. B. Pybas; Tennessee River, Dr. Edgar; Holston River, Miss Annie E. Law and Prof. Cope.

My cabinet and cabinet of Dr. Lewis.

Diam. 1·1,

Length 1·4,

Breadth 1·9 inch.

Shell smooth, oblique, clubshaped, swollen before, very inequilateral, obtusely angular behind; substance of the shell thick, somewhat thicker before; beaks prominent and almost terminal, undulate at the tips; ligament short and dark brown; epidermis yellowish with numerous interrupted rays nearly over the whole disk, with rather close lines of growth; umbonial slope rounded; posterior slope cordate, very slightly raised; cardinal teeth small, acuminate, crenulate, double in the left and disposed to be treble in the right valve; lateral teeth rather long, somewhat curved and lamellar; anterior cicatrices distinct, small and deeply impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks shallow and rounded; nacre white and iridescent.

Remarks.—A single young specimen of this species was sent to me at least twenty years since by the late Dr. Edgar. Subsequently, ten or twelve years ago, Mr. Pybas sent me two or three half-grown specimens. Recently I have received from Dr. Lewis, of Mohawk, N. Y., five specimens, two of which are mature. Until the receipt of these I could not satisfy myself entirely that the specimens so long held in doubt were specifically distinct from closely allied species. These at once satisfied all my doubts. More recently I owe to Prof. Cope a single half-grown specimen from the head waters of the Holston River. This species belongs to the group of which *clavus*, Lam., may be considered the type. It differs from that species in not having the beaks so prominent and terminal. It is very closely allied to *Lesleyi* (nobis), but it is not so compressed as that, nor so flat on the sides.

It is also near to *Murrayensis* (nobis) and to *mundus* (nobis). One of the young specimens has two or three undulations at the tips of the beaks. I have great pleasure in naming this species after Miss Annie E. Law, of Concord, East Tennessee. She has been a most energetic and successful collector of the mollusks in the streams of that part of the State where she resides, and which have never been so well examined as by herself.

UNIO OBUNCUS. Pl. 2, fig. 5.

Testa lævi, triangulari, subinflata, inæquilaterali, antice rotunda, postice obtuse angulata; valvulis crassis, antice crassioribus; natibus prominentibus; epidermide dilute oliva, perradiata; dentibus cardinalibus parvis corrugatisque; lateralibus crassis, lamellatis corrugatisque; margarita argentea et iridescente.

Shell smooth, triangular, somewhat inflated, inequilateral, round before, obtusely angular behind; valves thick, thicker before; beaks prominent; epidermis pale olive, much radiated; cardinal teeth small and corrugate; lateral teeth thick, lamellar and corrugate; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 192.

Hab.—Tuscumbia, Ala., L. B. Thornton; Holston River, E. Tenn., Miss Law.

My cabinet and cabinet of Dr. Lewis.

Diam. .8, Length 1.3, Breadth 1.5 inch.

Shell smooth, triangular, somewhat inflated, inequilateral, round before and obtusely angular behind; substance of the shell thick, thicker before; beaks prominent, somewhat pointed; ligament short, rather thick and brown; epidermis pale olive, rayed all over, somewhat polished, with distant marks of growth; umbonial slope raised into an obtuse angle and curved slightly inward towards the basal margin; posterior slope subcordate, with thin rays from the beaks to margin; cardinal teeth small, thick, and much corrugated; lateral teeth thick, lamellar and corrugated; anterior cicatrices distinct, small and deeply impressed; posterior cicatrices distinct, rather small and well impressed; dorsal cicatrices placed along the base of the cardinal tooth; cavity of the shell shallow and wide; cavity of the beaks deep and angular; nacre silvery white and iridescent.

Remarks.—There are seven specimens before me; they were all sent by Miss Law to Dr. Lewis. It is a pretty little species, closely allied to *Edgarianus* (nobis), and has some resemblance to young *Mooreisianus* (nobis). Like *Edgarianus* it has fine green rays, but it has not the great inflation of the anterior half of the disk, like that species, nor has it the high polish, nor the deep green rays on the anterior portion. It is also closely allied to *Tuscumbiensis* (nobis), but may be distinguished

by its being rather more compressed, having higher beaks, a greener looking epidermis, and in being more pyramidal. In outline it reminds one of the pyramidal form of the young of *pyramidatus* (nobis). Neither of the specimens was perfect enough at the beaks to observe the undulations.

UNIO RECURVATUS. Pl. 2, fig. 6.

Testa lævi, rotundata, valde inflata, valde inæquilaterali, antice rotundata, postice obtuse angulata; valvulis crassis, antice crassioribus; natibus valde prominentibus et recurvatis; epidermide fusca, eradiata; dentibus cardinalibus parvis, crassis sulcatisque; lateralibus percrassis, curtis, subcurvis corrugatisque; margarita argentea et iridescente.

Shell smooth, rounded, very much inflated, very inequilateral, rounded before, obtusely angular behind; valves thick, thicker before; beaks very prominent and recurved; epidermis brown and rayless; cardinal teeth small, thick and sulcate; lateral teeth very thick, short, somewhat curved, and roughened; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 192.

Hab.—Tennessee River, J. G. Anthony; Holston River, E. Tenn., Miss Law.

My cabinet, and cabinets of Mr. Anthony, Mr. Wheatley, and Dr. Lewis.

Diam. 1,

Length 1·5,

Breadth 1·6 inch.

Shell smooth, rounded, very much inflated, very inequilateral, round before and obtusely angular behind; substance of the shell thick, thicker before; beaks very prominent and much recurved; ligament short, thick and brown; epidermis brown, without rays, and with very close marks of growth; umbonial slope very much raised and obtusely angular; posterior slope cordate; cardinal teeth small, thick, sulcate, and disposed to be treble in the right valve; lateral teeth very thick, short, somewhat curved and corrugate; anterior cicatrices distinct, rather small and deeply impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices placed over the centre of the cavity of the beaks; cavity of the shell deep and rounded; cavity of the beaks deep and obtusely angular; nacre silvery white and iridescent.

Remarks.—There are three specimens before me. One of them, belonging to Mr. Anthony, has been in my possession for many years. I was never satisfied that it was not a variety of *ebenus* (nobis) until lately, when I received two other specimens, which were sent by Miss Law to Dr. Lewis and Mr. Wheatley. Comparing the three specimens with the allied species, I became entirely satisfied that the species was distinct. In the above description of the epidermis it is said to be without rays. It is very likely that young and perfect specimens may be found with some rays. Two of these specimens have three or four spots immediately

under the marks of growth before the umbonial slope. The epidermis is disposed to be rough and slightly scaly, like *plenus* (nobis), and it has a general resemblance to that species, but it is rounded and has not the flattened side of that species. Neither of the specimens is perfect enough in the beaks to display undulations. I owe to the kindness of Dr. Lewis in being able to cite my cabinet for a specimen.

UNIO TUSCUMBIENSIS. Pl. 3, fig. 7.

Testa lævi, triangulari, tumida, ad latere planulata, inæquilaterali, antice subtruncata, postice obtuse angulata; valvulis crassis, antice crassioribus; natibus elevatis, subretusis; epidermide luteo-oliva, perradiata; dentibus cardinalibus parviusculis, subcompressis crenulatisque; lateralibus curtis, subcrassis subrectisque; margarita argentea et iridescente.

Shell smooth, triangular, swollen, flattened at the sides, inequilateral, subtruncate before, obtusely angular behind; valves thick, thicker before; beaks raised, somewhat retuse; epidermis yellowish olive, very much rayed; cardinal teeth rather small, somewhat compressed and crenulate; lateral teeth short, somewhat thick and straight; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 190.

Hab.—Tuscumbia, Ala., L. B. Thornton, Esq.; Holston River, E. Tenn., Dr. Edgar.

My cabinet.

Diam. .9, Length 1.3, Breadth 1.6 inch.

Shell smooth, triangular, inflated, flattened at the sides, inequilateral, subtruncate before and obtusely angular behind; substance of the shell thick, thicker before; beaks prominent and somewhat retuse; ligament very short, reddish brown; epidermis yellowish olive, rayed nearly over the whole disk, with rather close marks of growth; umbonial slope raised and obtusely angular; posterior slope flattened and cordate; cardinal teeth rather small, somewhat compressed, crenulate, double in the left and treble in the right valve; lateral teeth short, somewhat thick and nearly straight; anterior cicatrices distinct, small and deeply impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices placed on the under side of the plate within the cavity of the beaks; cavity of the shell rather deep and rounded; cavity of the beaks rather deep and obtusely angular; nacre very white and iridescent.

Remarks.—Dr. Edgar more than twenty years since sent me a single specimen of this species, which is so closely allied to *cuneolus* (nobis) that I placed it among that species as a variety. Subsequently Mr. Thornton sent me three of different ages, and I have no longer any doubt but that they are distinct. It may be distin-

gished from *cuneolus* by its being more triangular, approaching the outline of typical *obliquus*, Lam. *Tuscumbiensis* is also closely allied to *Edgarianus* (nobis), but differs in being less tumid, less polished, and less extended at the anterior basal margin. None of the specimens are perfect enough at the beaks to exhibit undulation at the tips.

UNIO APPRESSUS. Pl. 3, fig. 8.

Testa lævi, triangulari, securiformi, valde inæquilaterali, antice rotundata, postice subangulata; valvulis crassiusculis, antice aliquanto crassioribus; natibus prominentibus; epidermide flavida, radiis interruptis postice indutis; dentibus cardinalibus paviusculis, compressis crenulatisque; lateralibus sublongis, curvis lamellatisque; margarita argentea et aliquanto iridescente.

Shell smooth, triangular, securiform, very inequilateral, rounded before, subangular behind; valves somewhat thick, somewhat thicker before; beaks prominent; epidermis yellowish, covered behind with interrupted rays; cardinal teeth somewhat small, compressed, and crenulate; lateral teeth rather long, curved, and lamellar; nacre silvery white and somewhat iridescent.

Proc. Acad. Nat. Sci., 1871, p. 189.

Hab.—Tuscumbia, Ala., B. Pybas; Tennessee River, J. G. Anthony; Holston River, Miss Law and C. M. Wheatley.

My cabinet; cabinets of Mr. Anthony and Dr. Lewis.

Diam. .9,

Length 1.5,

Breadth 1.7 inch.

Shell smooth, triangular, securiform, very inequilateral, rounded before and obtusely angular behind; substance of the shell somewhat thick, thicker before; beaks prominent; ligament rather short and dark brown; epidermis yellowish, with interrupted rays on the posterior part near to the umbonial slope, with numerous rather close lines of growth; umbonial slope obtusely angular; posterior slope narrow elliptical, slightly raised, and without rays; cardinal teeth rather small, compressed, and crenulate; lateral teeth rather long, curved, lamellar, and rather blunt at the end; anterior cicatrices distinct, small and deeply impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell shallow and rounded; cavity of the beaks rather deep and obtusely angular; nacre very white and somewhat iridescent.

Remarks.—There are six specimens before me; four of them have been with me for many years, laid aside for further and better lights; the other two specimens were recently received from Dr. Lewis, having been obtained from the Holston River by Miss Law. Neither of these six specimens can be placed in any species with which I am acquainted. In outline this species is perhaps nearest to *abacus*,

Hald. It differs in being rather less appressed, rather more rounded in outline, and in having interrupted rays. It reminds one of *dolabelloides* (nobis), but it is more triangular. None of the specimens are perfect enough at the beaks to display undulations.

UNIO RADIOSUS. Pl. 3, fig. 9.

Testa lævi, subtriangulari, subinflata, subequilateriali, antice rotundata, postice obtuse angulari; valvulis crassiusculis, antice parum crassioribus; natibus prominentibus; epidermide luteo-oliva, perradiata; dentibus cardinalibus parvis, compressis crenulatisque; lateralibus subcrassis, lamellatis subrectisque; margarita alba et iridescente.

Shell smooth, subtriangular, somewhat inflated, subequilateral, rounded before, obtusely angular behind; valves somewhat thick, somewhat thicker before; beaks prominent; epidermis yellowish-olive, very much rayed; cardinal teeth small, compressed and crenulate; lateral teeth somewhat thick, lamellar and nearly straight; nacre white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 192.

Hab.—Holston River, East Tennessee, Miss A. E. Law.

My cabinet, and cabinets of Dr. Lewis, Mr. Wheatley and Miss Law.

Diam. .7, Length 1.1, Breadth 1.4 inch.

Shell smooth, subtriangular, somewhat inflated, nearly equilateral, rounded before and obtusely angular behind; substance of the shell rather thick, somewhat thicker before; beaks prominent; ligament short, thick and brown; epidermis yellowish-olive, very much rayed, with rather distant marks of growth; umbonial slope raised and obtusely angular; posterior slope cordate and generally rayed; cardinal teeth small, compressed, crenulate and disposed to be treble in the right valve; lateral teeth rather thick, short, lamellar and nearly straight; anterior cicatrices distinct, small and deeply set; posterior cicatrices distinct, small and well impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell rather deep and rounded; cavity of the beaks rather deep and obtusely angular; nacre white and iridescent.

Remarks.—This species is closely allied to *tumescens* (nobis) in outline, in size and in color of the epidermis. It may, however, be distinguished by *radiosus* being rather more compressed, having a yellowish epidermis with more rays, which usually are broader and greenish. Some of the specimens are nearly covered with beautiful broad green rays. *Tumescens* has higher beaks, a darker epidermis and fewer rays. It is also usually thicker in the substance of the shell. None of the beaks of nearly a dozen before me, sent by Miss Law, are perfect enough to show

undulations of the tips. I owe to the kindness of Dr. Lewis the possession of several specimens for my own cabinet.

UNIO CRUDUS. Pl. 4, fig. 10.

Testa lævi, subrotunda, compressa, inæquilaterali, antice rotunda, postice obtuse angulata; valvulis subcrassis, antice crassioribus; natibus prominentibus; epidermide rugosa, tenebroso-fusca, eradiata; dentibus cardinalibus subgrandibus, subcompressis crenulatisque; lateralibus crassis, subbrevis subcurvisque; margarita argentea et parum iridescente.

Shell smooth, subrotund, compressed, inequilateral, rounded before, obtusely angular behind; valves somewhat thick, thicker before; beaks prominent; epidermis rugose, dark brown, without rays; cardinal teeth somewhat large, subcompressed and crenulate; lateral teeth thick, rather short and somewhat curved; nacre silver white and somewhat iridescent.

Proc. Acad. Nat. Sci., 1871, p. 190.

Hab.—French Broad River, Pres. Lindsley; Swamp Creek, Murray Co., Geo., Major Downie; Holston River, C. M. Wheatley and Miss Law.

My cabinet, and cabinets of Mr. Wheatley and Dr. Lewis.

Diam. .9, Length 1.5, Breadth 1.8 inch.

Shell smooth, subrotund, compressed on the sides, inequilateral, round before and obtusely angular behind; substance of the shell rather thick, much thicker before; beaks prominent, rather pointed; ligament short, rather thick and dark brown; epidermis rough, dark brown, with rather distant marks of growth and without rays; umbonial slope rounded and flattened; posterior slope compressed, cordate, with two slightly impressed lines; cardinal teeth rather large, rather compressed and crenulate; lateral teeth thick, rather short and somewhat curved; anterior cicatrices distinct, rather small, but well impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices placed on the under side of the plate within the cavity of the beaks; cavity of the shell shallow; cavity of the beaks rather shallow and obtusely angular; nacre silvery white and slightly iridescent.

Remarks.—Among the many shells sent to me some twelve years since by President Lindsley, of Nashville, was a single adult specimen of this species with imperfect beaks. Subsequently a young one was sent by Major Downie, and very recently Mr. Wheatley has sent me an adult and Dr. Lewis two quite young specimens. These last three entirely satisfy my mind that the species is undescribed, and I no longer doubt of its place in the system. The two old specimens are rather rough in the epidermis and present no appearance of rays; but the three young are yellowish, with interrupted dark rays. The outline is rounded, very

much like *subrotundus* (nobis), and altogether it is nearly allied to that species. None of the specimens have beaks perfect enough to display undulations at the tips.

UNIO CIRCUMACTUS. Pl. 4, fig. 11.

Testa lævi, rotundata, ad apices inflata, ad basim compressa, inæquilaterali; valvulis crassis, antice crassioribus; natibus elevatis recurvatisque; epidermide vel rufo-fusca vel castanea, maculata et radiata; dentibus cardinalibus crassis, subcompressis sulcatisque; lateralibus percrassis, subcurvis corrugatisque; margarita argentea et valde iridescente.

Shell smooth, rounded, inflated at the beaks, compressed at the base, inequilateral; valves thick, thicker before; beaks raised and recurved; epidermis reddish-brown or chestnut, maculate and rayed; cardinal teeth thick, somewhat compressed and sulcate; lateral teeth very thick, somewhat curved and corrugate; nacre silver white and very iridescent.

Proc. Acad. Nat. Sci., 1871, p. 192.

Hab.—Florence, Ala., Rev. G. White; Holston River, Miss Law.

My cabinet, and cabinets of Mr. Wheatley and Dr. Lewis.

Diam. 1·1,

Length 1·8,

Breadth 1·9 inch.

Shell smooth, rounded, inflated towards the beaks and compressed at the base, inequilateral; substance of the shell thick, thicker before; beaks much elevated and recurved; ligament thick, short and dark brown; epidermis dark brown or chestnut color, with rather close marks of growth; umbonial slope rounded, not raised; posterior slope narrow, cordate, in some specimens slightly maculate; cardinal teeth thick, somewhat compressed, and disposed to be treble in the right valve, sulcate; lateral teeth very thick, slightly curved and corrugate; anterior cicatrice distinct, rather small and deeply impressed; posterior cicatrices distinct, rather small and well impressed; dorsal cicatrices placed under the cardinal teeth within the cavity; cavity of the shell rather shallow and wide; cavity of the beaks shallow and obtusely angular; nacre silvery white and very iridescent.

Remarks.—This species so closely resembles *Thorntonii* (nobis) that I was induced to place the first I saw with that species as a variety. Having now seven or eight specimens before me, I am satisfied as to the value of the specific difference. All these specimens have a row of maculations immediately before the umbonial slope, extending nearly to the margin. On the anterior half there are rays and on the superior half maculations. This species belongs to the same group with *dolabelloides*, but this species is more rounded on the margin. None of the specimens before me are perfect enough at the tips to present undulations.

UNIO PATTINOIDES. Pl. 4, fig. 12.

Testa lævi, obliqua, subcompressa, valde inæquilaterali, antice rotundata, postice obtuse angulata; volvulis subcrassis, antice crassioribus; natibus sabprominentibus, fere terminalibus; epidermide luteo-brunnea, maculata; dentibus cardinalibus parvis, subcompressis sulcatisque; lateralibus longiusculis, subcompressis corrugatisque; margarita argentea et iridescente.

Shell smooth, oblique, somewhat compressed, very inequilateral, rounded before, obtusely angular behind; valves rather thick, thicker before; beaks somewhat prominent, nearly terminal; epidermis yellowish-brown and maculate; cardinal teeth small, somewhat compressed and sulcate; lateral teeth somewhat long, compressed and corrugate; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 193.

Hab.—Clinch River, Pres. Estabrook; Holston River, Dr. Edgar and Miss Law.

My cabinet, and cabinets of C. M. Wheatley and Dr. Lewis.

Diam. 1,

Length 1·4,

Breadth 1·8 inch.

Shell smooth, oblique, somewhat compressed, very inequilateral, rounded before and obtusely angular behind; substance of the shell rather thick, thicker before; beaks rather prominent, nearly terminal; ligament rather short, thick and dark brown; epidermis yellowish-brown, spotted with green interrupted rays, with rather close marks of growth; umbonal slope slightly raised and rounded; posterior slope narrow, cordate, occasionally with a few maculations; cardinal teeth small, somewhat compressed and sulcate; lateral teeth rather long, somewhat compressed and corrugate; anterior cicatrices distinct, rather small and deeply impressed; posterior cicatrices distinct, rather small and moderately impressed; dorsal cicatrices placed on the base of the cardinal teeth within the cavity of the shell; cavity of the shell wide and rounded; cavity of the beaks rather deep and angular; nacre silver white and iridescent.

Remarks.—I have had two old and worn specimens of this species for many years, always unable to place them satisfactorily in any described species with which I was acquainted. Recently Miss Law has sent several young and more perfect specimens, and I no longer doubt of their being distinct. In outline it is near to *mundus* and *Lesleyi* (nobis), but *mundus* has higher beaks, and both are rather more oblique. None of these specimens have the beaks perfect enough to show the undulations at the tips.

UNIO LITUS. Pl. 5, fig. 13.

Testa lævi, elliptica, subcompressa, inæquilaterali, antice rotundata, postice subbiangulata; valvulis subtenuibus, antice crassioribus; natibus prominulis; epidermide crocea, eradiata; dentibus cardinalibus parvis compressisque; lateralibus sublongis, subcurvis lamellatisque; margarita salmonis colore tincta et elegantissime iridescente.

Shell smooth, elliptical, somewhat compressed, inequilateral, rounded before, subbiangular behind; valves rather thin, thicker before; beaks a little prominent; epidermis saffron-yellow, without rays; cardinal teeth small and compressed; lateral teeth rather long, somewhat curved and lamellar; nacre salmon color and elegantly iridescent.

Proc. Acad. Nat. Sci., 1871, p. 189.

Hab.—Cahaba River, Shelby Co., Ala., E. R. Schowalter, M.D.

My cabinet, and cabinet of E. R. Schowalter, M.D.

Diam. .6, Length 1, Breadth 1.6 inch.

Shell smooth, elliptical, somewhat compressed, inequilateral, rounded before and subbiangular behind; substance of the shell rather thin, thicker before; beaks a little prominent; ligament short and light brown; epidermis saffron-yellow, without rays, with rather distant lines of growth; umbonial slope rounded; posterior slope elliptical and slightly carinate; cardinal teeth small, compressed, double in the left and treble in the right valve; lateral teeth short, oblique, and lamellar; anterior cicatrices confluent, rather large and well impressed; posterior cicatrices large, confluent and slightly impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks rather shallow and obtusely angular; nacre salmon color, deeper on the margin, brilliant, satin like, very iridescent.

Remarks.—This is a small species, with a beautiful satin-like nacre. There are two specimens before me; one apparently full grown, the other more than half mature. In color of exterior and general phase it reminds one of *striatulus* (nobis), but it differs in outline, that shell being subtriangular, while *litus* is elliptical. In outline it is very near to *Copei* (nobis), but altogether different in color of epidermis as well as in the nacre. In both specimens before me the beaks are eroded.

UNIO CAHABENSIS. Pl. 5, fig. 14.

Testa valde tuberculata, quadrata, compressa, subæquilaterali, antice rotunda, postice truncata; valvulis subcrassis, antice crassioribus; natibus subprominentibus; epidermide crocea, eradiata; dentibus cardinalibus subgrandis, compressis crenulatisque; lateralibus curtis, obliquis lamellatisque; margarita salmonis colore tincta et elegantissime iridescente.

Shell very much tuberculate, quadrate, compressed, subequilateral, rounded before, truncate behind; valves rather thick, thicker before; beaks rather prominent; epidermis saffron-yellow, without rays; cardinal teeth rather large, compressed and crenulate; lateral teeth short, oblique and lamellar; nacre salmon color and elegantly iridescent.

Proc. Acad. Nat. Sci., 1871, p. 190.

Hab.—Cahaba River, Shelby Co., Ala., E. R. Schowalter, M.D.

My cabinet, and cabinet of E. R. Schowalter, M.D.

Diam. .8,

Length 1.5,

Breadth 1.8 inch.

Shell tuberculate nearly over the whole disk, quadrate, subequilateral, round before and truncate behind; substance of the shell rather thick, much thicker before; beaks somewhat prominent; ligament short, rather dark; epidermis saffron-yellow, without rays, with distant lines of growth; umbonial slope flattish; posterior slope compressed, carinate, with many small tubercles; cardinal teeth rather large, compressed, crenulate, double in the left and treble in the right valve; lateral teeth short, oblique, lamellar and straight; anterior cicatrices distinct and well impressed; posterior cicatrices distinct and slightly impressed; dorsal cicatrices placed within the cavity of the beaks; cavity of the beaks deep and angular; cavity of the shell shallow and wide; nacre salmon color, splendent and satinlike, deeper colored on the margin.

Remarks.—Two specimens only were sent by Dr. Schowalter. The larger appears to be full grown; the smaller rather more than half mature. The beautiful salmon color and satinlike nacre of these specimens are very remarkable, the color extending from the margin into the cavity of the beaks. It belongs to the quadrate nodulous group which contains *lachrymosus*, *pustulatus*, *Schoolcraftii*, &c., the outline and compressed form being nearly the same with the latter. It differs entirely in having very numerous tubercles over three-fourths of the disk, the anterior fourth being somewhat welted. It is devoid of the broad green ray which is usually so well defined in *Schoolcraftii*, no appearance of rays being in the two specimens before me. The very remarkably fine nacre displays a series of irregular undulations, caused by the exterior tubercles. The beaks of both specimens being eroded, present no undulations.

UNIO SIMULANS. Pl. 5, fig. 15.

Testa lævi, obliqua, subcompressa, inæquilaterali, antice rotundata, postice obtuse angulata; valvulis crassiusculis, antice crassioribus; natibus prominentibus; epidermide tenebroso-fusca, eradiata; dentibus cardinalibus parvis, compressis crenulatisque; lateralibus sublongis, curvis lamellatisque; margarita alba et iridescente.

Shell smooth, oblique, somewhat compressed, inequilateral, rounded before and obtusely angular behind; valves rather thick, thicker before; beaks a little prominent; epidermis dark brown without rays; cardinal teeth small, compressed, and crenulate; lateral teeth somewhat long, curved and lamellar; nacre white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 190.

Hab.—Cahaba River, Shelby Co., Ala., E. R. Schowalter, M.D.

My cabinet, and cabinet of Dr. Schowalter.

Diam. .6, Length 1, Breadth 1.5 inch.

Shell smooth, oblique, somewhat compressed, inequilateral, rounded before, obtusely angular behind; substance of the shell somewhat thick, somewhat thicker before; beaks a little prominent; ligament short and dark brown; epidermis dark brown, nearly black, without rays and with rather distant marks of growth; umbonial slope rounded; posterior slope narrow elliptical, with two indistinct rays on each valve, scarcely carinate; cardinal teeth small, compressed and crenulate; lateral teeth rather long, curved and lamellar; anterior cicatrices distinct, rather small, deeply impressed; posterior cicatrices confluent and slightly impressed; dorsal cicatrices placed over the centre of the cavity of the beaks; cavity of the shell rather shallow and wide; cavity of the beaks somewhat deep and obtusely angular; nacre white and iridescent behind.

Remarks.—Four specimens of this species were sent to me by Dr. Schowalter. They seem all to be males. The species seems to be more nearly allied to *U. Genthii* (nobis) than any other I am acquainted with. It differs in being more compressed, and in being a little more oblique. When young the color of the epidermis is no doubt a dark green. The most perfect specimen shows a disposition to exhibit that color. None of the specimens had beaks perfect enough to show undulations at the tips, which no doubt they possess when young.

UNIO DISPANSUS. Pl. 6, fig. 16.

Testa lævi, elliptica, subinflata, valde inæquilaterali, antice rotunda, postice obtuse angulata; valvulis crassiusculis, antice crassioribus; natibus prominulis, fere terminalibus; epidermide tenebrosolivacea, perradiata; dentibus cardinalibus parviusculis tuberculatis et in utroque valvulo duplicibus; lateralibus prolongis, lamellatis subrectisque; margarita purpurea et valde iridescente.

Shell smooth, elliptical, somewhat inflated, very inequilateral, round before and obtusely angular behind; valves somewhat thick, thicker before; beaks a little prominent, nearly terminal; epidermis dark olive, very much rayed; cardinal teeth rather small, tuberculate and double in both valves; lateral teeth very long, lamellar and nearly straight; nacre purple and very iridescent.

Proc. Acad. Nat. Sci., 1871, p. 191.

Hab.—East Tennessee, Dr. Edgar.

My cabinet.

Diam. .8,

Length 1.2,

Breadth 2.2 inches.

Shell smooth, narrow elliptical, somewhat inflated, very inequilateral, round before and obtusely angular behind; substance of the shell somewhat thick, thicker before; beaks rather prominent, nearly terminal; ligament rather long and dark brown; epidermis dark olive and very much rayed on the posterior portions, with rather close marks of growth; umbonial slope slightly raised and rounded; posterior slope narrow elliptical; cardinal teeth rather small, tuberculate and double in both valves; lateral teeth very long, lamellar and nearly straight; anterior cicatrices distinct, rather large and well impressed; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices placed in a row across the centre of the cavity of the beaks; cavity of shell rather deep and wide; cavity of the beaks shallow and nearly rounded; nacre purple and very iridescent.

Remarks.—Among the shells sent to me many years since were two specimens which I could not place with any I was acquainted with. These have been laid aside with the hope of getting others of different ages, better to satisfy myself. Since then, among all the many *envois* from East Tennessee, I have never seen a third specimen. I am now, however, satisfied from the view of many allied species, that these must be placed in the group of *rutilans* (nobis) as distinct, being near to that and *subellipsis* (nobis). It is not so large a species as *rutilans*, nor so transverse, and differs in having a purple nacre, and in this respect differs from *subellipsis*, to which it has a strong resemblance. The nacre of the two specimens before me is purple in the cavity, being more intense towards the cavity of the beaks, and inclining to salmon color towards the margin. It is exceedingly brilliant in the posterior half of the disk. The beaks being eroded, the undulations of the tips were not observable. Dr. Edgar did not mention the particular habitat of those specimens, but they probably came from the Holston River.

UNIO SANTEENSIS. Pl. 6, fig. 17.

Testa lævi, suboblonga, subinflata, valde inæquilaterali, antice rotundata, postice obtuse biangulata; valvulis crassiusculis, natibus prominulis, ad apices minute undulatis; epidermide tenebroso-fusca, nitida et valde radiata; dentibus cardinalibus parvis, compressis et in utroque valvulo duplicibus; lateralibus longis subcurvisque; margarita vel purpurea vel salmonis colore tineta et iridescente.

Shell smooth, somewhat oblong, somewhat inflated, very inequilateral, rounded before, obtusely biangular behind; valves somewhat thick; beaks slightly promi-

ment, minutely undulate at the tips; epidermis dark brown, shining, and very much radiate; cardinal teeth small, much compressed and double in both valves; lateral teeth long and somewhat curved; nacre purple or salmon colored and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 193.

Hab.—Santee Canal, So. Car., Dr. Foreman; and Oconee River, Geo., Major J. Le Conte.

My cabinet.

Diam. .9, Length 1.4, Breadth 2.5 inches.

Shell smooth, somewhat oblong, rather inflated, very inequilateral, rounded before, obtusely biangular behind; substance of the shell a little thick; beaks a little prominent, minutely undulate at the tips; ligament rather long and dark brown; epidermis dark brown, shining and very much rayed, with very distant marks of growth; umbonial slope inflated and rounded; posterior slope narrow elliptical and with two slightly impressed lines from the beaks to the posterior margin; cardinal teeth small, compressed, double in both valves; lateral teeth long and somewhat curved; anterior cicatrices distinct and well impressed; posterior cicatrices large, confluent and moderately impressed; dorsal cicatrices placed over the centre of the cavity of the beaks; cavity of the shell rather deep and wide; cavity of the beaks shallow and rounded; nacre purplish, tinted with salmon and iridescent.

Remarks.—This species is closely allied to *confertus* (nobis) and *lugubris* (nobis), and belongs to the great *complanatus* group. It is rather more compressed than either of them, and is not quite so elongate. In color of epidermis and rays it resembles both. Three specimens have been in my collection for many years, and they were placed with a doubt as a variety of *lugubris*. I no longer hesitate to believe it to be a distinct species.

UNIO RADIOLUS. Pl. 6, fig. 18.

Testa lævi, elliptica, subinflata, valde inæquilaterali, antice rotunda, postice obtuse angulata; valvulis crassiusculis; natibus prominulis, fere terminalibus; epidermide brunnea, valde radiata; dentibus cardinalibus parvis, subcompressis crenulatisque; lateralibus longis, lamellatis subcurvisque; margarita alba et iridescente.

Shell smooth, elliptical, somewhat inflated, very inequilateral, round before, obtusely angular behind; valves somewhat thick; beaks a little prominent, nearly terminal; epidermis brownish, very much radiate; cardinal teeth small, somewhat compressed and crenulate; lateral teeth long, lamellar and somewhat curved; nacre white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 192.

Hab.—Ogeechee River, Liberty Co., Geo., Major John Le Conte.

My cabinet and cabinet Academy Natural Sciences.

Diam. .8, Length 1.1, Breadth 2.1 inches.

Shell smooth, narrow elliptical, somewhat inflated, inequilateral, round before and obtusely angular behind; substance of the shell somewhat thick; beaks a little prominent and nearly terminal; ligament rather short, rather thick and dark brown; epidermis brownish, very much rayed and with distant marks of growth; umbonial slope raised and obtusely angular; posterior slope narrow elliptical and raised into a small carina; cardinal teeth small, compressed and crenulate; lateral teeth long, lamellar and somewhat curved; anterior cicatrices distinct, rather small and well impressed; posterior cicatrices confluent, rather large and moderately impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell rather deep and wide; cavity of the beaks shallow and rounded; nacre white and iridescent.

Remarks.—I owe to the kindness of my friend, the late Major John Le Conte, a small suite of this species which some twenty years since he brought from Georgia. For a long time I considered these specimens to belong to *Geddingsianus* (nobis) from South Carolina. Having more recently given them a careful comparison with that species, I have no longer any hesitation in separating them. It is a smaller species, has a higher umbonial slope, is a little more transverse and has more and closer rays. It need not be confounded with *aquilus* (nobis), from Georgia, which is a more compressed species and is larger. The young specimens show delicate undulations at the tips of the beaks.

UNIO STEVENSII. Pl. 7, fig. 19.

Testa bialata, valde plicata, triangulari, compressa, valde inæquilaterali; valvulis crassiusculis, antice crassioribus; natibus vix prominentibus; epidermide tenebroso-cornea, eradiata; dentibus cardinalibus parvis sulcatisque; lateralibus longis, lamellatis subcurvisque; margarita alba et iridescente.

Shell double winged, very much folded, triangular, compressed, very inequilateral; valves somewhat thick, thicker before; beaks scarcely prominent; epidermis dark horn color, without rays; cardinal teeth small and sulcate; lateral teeth long, lamellar and somewhat curved; nacre white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 188.

Hab.—Yuruari River, tributary to Essequibo River, Guiana, R. P. Stevens.

My cabinet and cabinet of C. M. Wheatley.

Diam. 1, Length 1·8, Breadth 2·5 inches.

Shell bialate, folded nearly all over, triangular, compressed, very inequilateral; substance of the shell somewhat thick, thicker before; beaks scarcely prominent, with radiating folds at the tips; ligament concealed, long and dark brown; epidermis dark horn color, in the younger light horn color, without rays and with rather distant marks of growth; umbonial slope very slightly raised; posterior slope narrow elliptical and raised into a high wing; cardinal teeth small, sulcate; lateral teeth long, lamellar and slightly curved; anterior cicatrices confluent, rather small and well impressed; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices placed in a row across the cavity of the beaks; cavity of the shell very shallow and wide; cavity of the beaks very shallow and rounded; nacre white and iridescent.

Remarks.—I owe to the kindness of Mr. Stevens three specimens, two adults and young one about one-third grown. The outline is very nearly that of *Boykinianus* (nobis) and it is plicate like that shell nearly all over; but it differs in being a thinner and smaller shell, and in having more and smaller folds. In the young shell before me the folds extend over the whole disk and some of them take a zig-zag form. This is a symphynote species and the high wing in perfect specimens covers the ligament. In the two older specimens this character is lost, but in the young specimen it is evident that the two valves were connate before and behind the beaks. In all the three specimens the cardinal teeth are much divided and therefore disposed to be sulcate.

I have great pleasure in dedicating this species to Mr. Stevens, to whom I am under obligations for it and other interesting river shells taken by him in Guiana, viz., *Unio fluctiger*, *An. tortilis*, *An. ensiformis* and *Mel. transversa*.

UNIO JEFFREYSIANUS. Pl. 7, fig. 20.

Testa crebre et leviter sulcata, regulariter elliptica, compressa, parum inæquilaterali; valvulis crassiusculis, antice parum crassioribus; natibus prominulis; epidermide tenebroso-fusca, polita, eradiata; dentibus cardinalibus, parvis, lamellatis, obliquis; lateralibus longis, lamellatis, subrectis et in utroque valvulo simplicibus; margarita vel alba vel salmonis colore tincta.

Shell closely and slightly sulcate, regularly oval, compressed, somewhat inequilateral; valves somewhat thick, slightly thicker before; beaks a little prominent; epidermis dark brown, polished, without rays; cardinal teeth small, lamellar and oblique; lateral teeth long, lamellar, nearly straight and simple in both valves; nacre white or salmon colored.

Proc. Acad. Nat. Sci., 1871, p. 188.

Hab.—Australia, C. M. Wheatley.

My cabinet and cabinet of C. M. Wheatley.

Diam. 1,

Length 1·7,

Breadth 2·8 inches.

Shell closely and slightly sulcate, regularly elliptical, compressed, slightly inequilateral; substance of the shell somewhat thick, somewhat thicker before; beaks a little prominent; ligament very thin, long and nearly concealed; epidermis dark brown, shining, without rays, with very distant marks of growth; umbonial slope very slightly raised and rounded; posterior slope carinate, narrow elliptical; cardinal teeth small, lamellar, oblique, double in the right and single in the left valve; lateral teeth long, lamellar, nearly straight and single in both valves; anterior cicatrices confluent, large and slightly impressed; posterior cicatrices confluent, large and very slightly impressed; dorsal cicatrices placed in a row across the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks very shallow and rounded; nacre white or salmon color and slightly iridescent.

Remarks.—I owe to my friend Mr. Wheatley the possession of the specimen figured. He has two similar ones in his extensive and valuable collection. This species is remarkable for having the lateral teeth *single* in *both valves*. The cardinal teeth are small, and double only in the right valve, the upper lobe of the tooth of which is very small. The lines of growth are broad and very distant. The beaks are too imperfect to exhibit their character. In outline it is near to *Thwaitesii* (nobis), but it is higher in the carina than that shell and differs in the teeth as well as in the character of sulcation of the disk, *Thwaitesii* being smooth. It resembles also *vittatus* (nobis), but that species is more inflated, the beaks more terminal, and the marks of growth very much closer. It cannot be confounded with Lamarck's *Australis*, that species being smooth and obovate. (See *Philippi's Conchylien*, Tab. 5, fig. 5.)

I have great pleasure in dedicating this species to the distinguished and able author of *British Conchology*, &c., J. Gwyn Jeffreys, F.R.S., &c. &c.

ANODONTA EXILIOR. Pl. 7, fig. 21.

Testa alata, lævi, obovata, inflata, valde inæquilaterali; valvulis exilissimis; natibus prominulis, ad apices minute undulatis; epidermide vel olivacea vel brunea, polita et eradiata; margarita cœrulea et valde iridescente.

Shell winged, smooth, obovate, inflated, very inequivalve, valves exceedingly thin; beaks somewhat prominent, minutely undulate at the tips; epidermis olive or brown, polished and without rays; nacre blue and very iridescent.

Proc. Acad. Nat. Sci., 1871, p. 188.

Hab.—Mexico, C. M. Wheatley.

Diam. .7, Length 1.3, Breadth 1.8 inch.

Shell winged, smooth, obovate, inflated, very inequilateral; substance of the shell exceedingly thin; beaks a little prominent, at the tips very minutely undulate and pointed; ligament rather long, dark brown and nearly concealed; epidermis olive color or brownish, polished, without rays, and with distant marks of growth; umbonial slope inflated and rounded; posterior slope elliptical, raised into a wing; anterior cicatrices confluent, large and very slightly impressed; posterior cicatrix confluent and very slightly impressed; dorsal cicatrices placed across the cavity of the shell and very slightly impressed; cavity of the shell deep and rounded; cavity of the beaks exceedingly shallow; nacre bluish and very iridescent.

Remarks.—This very delicate species was kindly given to me by Mr. Wheatley, who obtained it from a London dealer as coming from Mexico. The habitat, therefore, is not positively certain. It does not appear to me to be a Mexican species. There are three specimens before me. The oldest one is dark brown with a polished epidermis, while the youngest is greenish olive. The very delicate nacre, which is translucent, has very minute striæ passing from the centre of the beaks to all parts of the margin. In outline it is closely allied to *A. obtusa* (Spix.), Testacea Fluv. Braziliencia, Tab. xxii. figs. 3 and 4; but differs entirely in the thinness of the valves, in not having rays, and in being higher in the wing.

UNIO MACNIELII. Pl. 8, fig. 22.

Testa sulcata, oblonga, valde inæquilaterali, antice sub-rotunda, postice obtuse biangulata; valvulis crassiusculis, antice crassioribus; natibus prominulis; epidermide fusca vel luteola, postice viridiradiata; dentibus cardinalibus parviusculis, compressis crenulatisque; lateralibus sublongis lamellatisque; margarita argentea et valde iridescente.

Shell sulcate, oblong, very inequilateral, rounded before, obtusely biangular behind; valves somewhat thick, thicker before; beaks slightly prominent; epidermis brownish or yellowish, with green rays posteriorly; cardinal teeth rather small, compressed and crenulate; lateral teeth rather long and lamellar; nacre white and very iridescent.

Proc. Acad. Nat. Sci., 1869, p. 124.

Hab.—Rio Gigillillo, Corcuera, Nicaragua, Cen. Am., Mr. J. A. McNiel.

My cabinet, and cabinet of the Peabody Academy Nat. Sci., Salem.

Diam. .7, Length 1, Breadth 1.7 inch.

Shell sulcate, oblong, very inequilateral, rounded before, obtusely biangular behind; substance of the shell somewhat thick, thicker before; beaks slightly prominent; ligament rather short and light brown; epidermis brownish, in the

young yellowish, with green rays behind, with scarcely perceptible lines of growth; umbonial slope rounded; posterior slope carinate, compressed, with two well-marked impressed lines from beaks to margin; cardinal teeth small, compressed, crenulate and disposed to be double in both valves; lateral teeth rather long, lamellar and slightly curved; anterior cicatrices distinct; posterior cicatrices confluent and moderately impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell somewhat deep; cavity of the beaks rather shallow and obtusely angular; nacre silver white and very iridescent.

Soft Parts.—No ova were found in the ovaries or branchial uterus. *Branchia* rather small, inner one the larger, curved below, free the whole length of abdominal sac. *Palpi* large, round below, united near to the top. *Mantle* very thin, thicker and colored at the margin. *Branchial Opening* rather large, light brown, with numerous small papillæ. *Anal Opening* large, dark brown, with numerous very minute papillæ on inner edges. *Super-Anal Opening* very small, colored, united below—color of the mass whitish.

Remarks.—I have before me a number of specimens of different ages. This species has a general resemblance to the Nicaraguan species, and is somewhat like *Rowellii* (nobis), but may be distinguished by the difference of outline, *Macnielii* being oblong, having nearly the outline of *Scamnatus Morelet*, from Cuba. I have pleasure in calling it after Mr. McNiel, who discovered it while travelling in Central America. I owe to the liberality of the Peabody Acad. Nat. Sci. of Salem the possession of specimens and the privilege of describing the species.

UNIO PEALEI. Pl. 8, fig. 23.

Testa lævi, rotunda, valde inflata, subglobosa, valde inæquilaterali, antice et postice rotundata; valvulis crassis, antice crassioribus; natibus elevatis, tumidis, subretusis; epidermide luteo-olivacea, dilute perradiata; dentibus cardinalibus paviusculis, subconicis; lateralibus longis, crassis subrectisque; margarita argentea et iridescente.

Shell smooth, round, very much inflated, subglobose, very inequilateral, round before and behind; valves thick, thicker before; beaks raised, swollen and somewhat retuse; epidermis pale olive with rather indistinct rays over the whole disk; cardinal teeth rather small, subconical; lateral teeth long, thick and nearly straight; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 191.

Hab.—Kansas, Mr. C. W. Peale.

Cabinet Academy Natural Sciences.

Diam. 1.2,

Length 1.7,

Breadth 2 inches.

Shell smooth, round, very much inflated, subglobose, very inequilateral, rounded before and behind; substance of the shell thick, much thicker before; beaks raised, swollen, somewhat retuse; ligament rather large and light brown; epidermis yellowish olive, with rather indistinct rays over the whole disk, and with rather distant marks of growth; umbonial slope rounded; posterior slope elliptical, with two indistinct impressed lines on each valve from the beak to the margin; cardinal teeth rather small, subconical, double in the left and treble in the right valve; lateral teeth long, thick and nearly straight; anterior cicatrices distinct, rather small and deeply impressed; posterior cicatrices confluent, rather large and well impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell deep and rounded; cavity of the beaks shallow and obtusely angular; nacre beautifully white and iridescent.

Remarks.—A single specimen only was brought by Mr. Peale from Kansas. It is always to be regretted that a description should be made from a single specimen, as the species of this genus often vary exceedingly. In outline it is perhaps nearest to *ebenus* (nobis), but it has not the high retuse beaks of that species, nor its dark margin or peculiar party color of the young shell. In the epidermis it is totally different. It is not quite so round as *circulus* (nobis), and differing so much in the epidermis, cannot be confounded with that species. In the color of the epidermis and indistinct rays it is allied to *ellipsis* (nobis), but it is not so oblique. The beaks are nearly perfect, and show indistinctly very minute undulations at the tips. I dedicate the species to Mr. Peale, who presented it to the Academy with many other species from the distant habitat of Kansas.

UNIO ACUENS. Pl. 8, fig. 24.

Testa lævi, triangulari, compressa, valde inæquilaterali, antice rotundata, postice subbiangulata; valvulis crassiusculis, antice crassioribus; natibus prominentibus; epidermide luteola, radiis interruptis; dentibus cardinalibus subcrassis, subcompressis crenulatisque; lateralibus subcrassis, brevis subrectisque; margarita alba et iridescente.

Shell smooth, triangular, compressed, very inequilateral, rounded before and subbiangular behind; valves somewhat thick, thicker before; beaks prominent; epidermis yellowish, with interrupted rays; cardinal teeth somewhat thick, somewhat compressed and crenulate; lateral teeth somewhat thick, short and nearly straight; nacre white and iridescent.

Proc. Acad. Nat. Sci., 1871, p. 190.

Hab.—Holston River, near Concord, East Tennessee, Miss A. E. Law.

My cabinet and cabinet of Dr. Lewis.

Diam. .7,

Length 1,

Breadth 1.2 inch.

Shell smooth, triangular, compressed, flattened at the sides, very inequilateral, rounded before and subbiangular behind; substance of the shell rather thick, thicker before; beaks prominent, almost terminal; ligament short and light brown; epidermis yellowish, with a few interrupted maculate rays near the umbonial slope, with close marks of growth; umbonial slope obtusely angular; posterior slope compressed cordate; cardinal teeth rather thick, somewhat compressed and crenulate; lateral teeth rather thick, short and nearly straight; anterior cicatrices distinct, small and deeply impressed; posterior cicatrices distinct, small and well impressed; dorsal cicatrices placed on the under side of the plate, within the cavity of the beaks; cavity of the shell very shallow; cavity of the beaks shallow and obtusely angular; nacre white and very iridescent.

Remarks.—Three specimens are before me, all found by Miss Law in the Holston River and sent to Dr. Lewis, to whom I am obliged for the advantage of describing the species and having one of them in my cabinet. In outline this species is near to *Clinchensis* (nobis), but may be distinguished at once by its flattened sides and more terminal beaks. In the marks of growth they differ much, *acuiens* having them much closer. In regard to the interrupted green rays they are very similar, but in *Clinchensis* these are more numerous and spread more over the disk. This species is also closely allied to *mundus* (nobis), but it is more compressed and less oblique. The only three specimens I have seen are nearly of the same size and are, I presume, adults. The beaks are too much eroded to present the character of undulations. Each of the specimens presents about a dozen marks of growth.

UNIO FLAVIDUS. Pl. 9, fig. 25.

Testa lævi, triangulari, subinflata, ad latere planulata, inæquilaterali, postice obtuse angulata, antice rotundata; valvulis subcrassis, antice crassioribus; natibus prominentibus, recurvatis, ad apices minute undulatis; epidermide flavida, radiis interruptis; dentibus cardinalibus parvis corrugatisque; lateralibus curtis, subcrassis subcurvisque; margarita argentea et iridescente.

Shell smooth, triangular, somewhat inflated, flattened at the sides, obtusely angular behind and rounded before; valves somewhat thick, thicker before; beaks somewhat prominent, incurved, minutely undulate at the tips; epidermis yellowish, with interrupted rays; cardinal teeth small and corrugate; lateral teeth short, rather thick and somewhat curved; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1872, p. 156.

Hab.—Clinch River, Anderson Co., and Holston River, East Tenn., Miss A. E. Law; North Alabama, Rev. G. White.

My cabinet and cabinets of Dr. Lewis and Mr. Wheatley.

Diam. .7, Length 1.2, Breadth 1.4 inch.

Shell smooth, triangular, somewhat inflated, flattened at the sides, obtusely angular behind and rounded before; substance of the shell somewhat thick, thicker before; beaks somewhat prominent, incurved, minutely undulate at the tip; ligament short, thick and light brown; epidermis yellowish, with interrupted green rays over about half of the disk, with rather close marks of growth; umbonial slope obtusely angular; posterior slope cordate, with an indistinct impressed line from the beaks to the margin; cardinal teeth small and corrugate; lamellar teeth short, rather thick, corrugate and somewhat curved; anterior cicatrices distinct, small and deeply impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices within the cavity of the beaks; cavity of the shell shallow; cavity of the beaks somewhat deep and angular; nacre silver white and iridescent.

Remarks.—This is another of Miss Law's species from Clinch River, and belongs to that group of triangular smooth *Uniones* of which *obliquus*, Lam. may be considered the type. It is very nearly of the same outline, but is more compressed, is a thinner shell and has not the beaks so much elevated. It also has some resemblance to *rubiginosus* (nobis), but is not rubiginose nor quite so angular. In outline very near to *Tuscumbiensis*, but more inflated. It may easily be distinguished from *tumescens* (nobis), an allied species, by the latter being more inflated and being of a darker color. The specimen from North Alabama sent to me many years since by Mr. White, is larger than the four from Miss Law, and is higher in the beaks, is more inflated and has more distant marks of growth. Indeed, Mr. White's specimen may prove, when we have more to examine, to be really distinct.

UNIO PAUCIPLICATUS. Pl. 9, fig. 26.

Testa plicata, subrotunda, ventricosa, valde inæquilaterali, postice carinata, antice rotundata; valvulis crassis, antice crassioribus; natibus prominentibus, tumidis, recurvatis, ad apices minute undulatis; epidermide rufo-fusca, eradiata; dentibus cardinalibus crassis, elevatis, sulcatis crenulatisque; lateralibus longis, lamellatis, corrugatis subcurvisque; margarita argentea et valde iridescente.

Shell plicate, subrotund, very much inflated, very inequilateral, carinate behind and rounded before; valves thick, thicker before; beaks prominent, swollen, recurved and minutely undulate at the tips; epidermis reddish-brown, without rays; cardinal teeth thick, raised, sulcate and crenulate; lateral teeth long, lamellar, corrugate and slightly curved; nacre silver white and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 156.

Hab.—Austin, Texas, Prof. C. G. Forshey, C. E.

My cabinet, and cabinets of Acad. Nat. Sci. and C. M. Wheatley.

Diam. 1·3, Length 2, Breadth 2·5 inches.

Shell plicate, subrotund, very ventricose, very inequilateral, carinate behind and rounded before; substance of the shell thick, thicker before; beaks prominent, swollen, recurved and minutely undulate at the tips; ligament long, thick and dark brown; epidermis reddish-brown, without rays, with very distant marks of growth; umbonial slope rounded; posterior slope carinate, with an impressed line in each valve from the beak to the margin; cardinal teeth thick, raised, sulcate, crenulate and disposed to be treble in the right valve; lateral teeth long, lamellar, corrugate and slightly curved; anterior cicatrices distinct, rather large, deeply impressed and very corrugate; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices placed on the under side of the cardinal teeth; cavity of the shell deep and rounded; cavity of the beaks deep and obtusely angular; nacre silver white and very iridescent.

Remarks.—Several specimens of this species were received from Prof. Forshey, with *purpuratus* Lam., *gracilis* Bar., *Berlandierii* (nobis), etc. When first received, I was disposed to think it to be a marked variety of *plicatus*, Lesueur, but it differs from that species in being rotund and in having fewer folds. In some specimens the folds are so obsolete as scarcely to be observed. The color of the epidermis is also different from *plicatus*. It has a rufous disposition mingling with a slight greenish tint in the only specimen before me, which is not old. All the specimens were dead shells. The inclination to redness in the epidermis is marked by a line of the hue around the margin of the nacre. The beaks of a single specimen are perfect enough to trace two or three very minute undulations at the tips. In its rotundness and some other characters it is closely allied to *Brazosensis* (nobis), and when good suites of both shall be obtained it may prove to be only a variety of that species.

UNIO LENTICULARIS. Pl. 9, fig. 27.

Testa lævi, subrotunda, compressa, lenticulari, subæquilaterali; postice obtuse biangulari, antice rotunda; valvulis subtenuibus, antice crassioribus; natibus prominulis; epidermide vel tenebroso-fusca vel luteo-fusca, obsolete radiata; dentibus cardinalibus parvis, compressis crenulatisque; lateralibus sublongis, lamellatis, corrugatis subcurvatisque; margarita albida et iridescente.

Shell smooth, rounded, compressed, lenticular, nearly equilateral, obtusely biangular behind, round before; valves rather thin, thicker before; beaks a little prominent; epidermis dark brown or yellowish-brown, obscurely rayed; cardinal teeth

small, compressed and crenulate; lateral teeth rather long, lamellar, corrugate and slightly curved; nacre whitish and iridescent.

Proc. Acad. Nat. Sci., 1872, p. 155.

Hab.—Tellico River, Monroe Co., East Tennessee, Miss A. E. Law.

My cabinet and cabinets of Dr. Lewis and C. M. Wheatley.

Diam. .7, Length 1.3, Breadth 1.7 inch.

Shell smooth, rounded, compressed, lenticular, nearly equilateral, obtusely biangular behind, round before; substance of the shell rather thin, thicker before; beaks a little prominent; ligament rather short, somewhat thin and light brown; epidermis dark brown or yellowish-brown, obscurely rayed and with close marks of growth; umbonial slope rounded; posterior slope compressed, subcarinate; cardinal teeth small, compressed, crenulate and very slightly curved; anterior cicatrices confluent, well impressed; posterior cicatrices distinct and moderately impressed; dorsal cicatrices placed on the upper side of the cavity of the beaks; cavity of the shell shallow, dishlike; cavity of the beaks rather shallow and obtusely angular; nacre white and iridescent.

Remarks.—Several specimens are before me. The figured specimen is subcircular and well characterizes the species. Some of the others are inclined to be more oblique, particularly where the beaks have been much eroded. In outline it is nearest to *Chickasawhensis* (nobis), but not quite so round, nor is it so much inflated. It is also a smaller species, has less robust cardinal teeth, and has closer marks of growth. This species is allied to *lens* (nobis), but that is compact and heavier. The rays on *lenticularis* are all, as those before me indicate, nearly obsolete. In young specimens the epidermis may be found to be yellowish-green and the interrupted rays no doubt well developed. None of the specimens sent by Dr. Lewis have beaks sufficiently preserved to exhibit undulations.

UNIO TELLICOENSIS. Pl. 10, fig. 28.

Testa lævi, subtriangulari, subinflata, inæquilaterali, postice obtuse angulata, antice rotunda; valvulis crassiusculis, antice parum crassioribus; natibus subprominentibus; epidermide crocata, polita, parum radiata; dentibus cardinalibus parvis, crenulatis, conicis; lateralibus curtis, subcrassis subrectisque; margarita salmonis colore tincta et valde iridescente.

Shell smooth, subtriangular, somewhat inflated, inequilateral, obtusely angular behind, round before; valves somewhat thick, a little thicker before; beaks somewhat prominent; epidermis brownish-saffron, polished, slightly radiated; cardinal teeth small, crenulate and conical; lateral teeth short, somewhat thick and nearly straight; nacre light salmon color and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 155.

Hab.—Tellico River, Monroe Co., East Tennessee, Miss A. E. Law; East Tennessee, J. C. Anthony.

My cabinet, and cabinet of Mr. J. C. Anthony.

Diam. .7, Length 1.8, Breadth 1.7 inch.

Shell smooth, subtriangular, somewhat inflated, inequilateral, obtusely angular behind and round before; substance of the shell somewhat thick, a little thicker before; beaks somewhat prominent; ligament small and dark brown; epidermis brownish-saffron, polished, with a few short interrupted, indistinct rays and with close marks of growth; umbonial slope obtusely angular; posterior slope compressed, cordate, with slightly impressed lines from the beaks to the margin; cardinal teeth small, crenulate and conical; lateral teeth short, somewhat thick and nearly straight; anterior cicatrices distinct, rather small and deeply impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices placed on the upper side of the cavity of the beaks; cavity of the shell rather deep and rounded; cavity of the beaks rather deep and subangular; nacre light salmon color, deeper towards the margin, very iridescent.

Remarks.—Two specimens only are before me; one was obtained by Miss Law and sent to Dr. Lewis, of Mohawk, N. Y. To him I am indebted for the possession of it. The other was found by Mr. Anthony. In outline this species is nearest to *glandaceus* (nobis), but may easily be distinguished by its being less inflated, less thick in the substance of the valves, in having a polished epidermis, closer marks of growth, and in the color being brownish-saffron. In the specimens before me there are only a few close interrupted pencil rays. Other specimens may be likely to have more rays, and some may be totally devoid of them. The beaks being eroded, no undulations can be observed. The color and polish of the epidermis are somewhat like those of *pyriformis* (nobis).

UNIO YADKINENSIS. Pl. 10, fig. 29.

Testa lævi, oblonga, compressa, valde inæquilaterali, postice subbiangulata, antice rotundata; valvulis crassis; natibus prominulis; epidermide tenebroso-fusca, eradiata; dentibus cardinalibus parvisculis, compressis, corrugatis, in utroque valvulo duplicibus; lateralibus longis, lamellatis, corrugatis subcurvisque; margarita vel salmonea vel purpurea et valde iridescente.

Shell smooth, oblong, compressed, very inequilateral, subbiangular behind, rounded before; valves thick; beaks slightly prominent; epidermis dark brown, without rays; cardinal teeth rather small, compressed, corrugate and double in both valves; lateral teeth long, lamellar, corrugate and somewhat curved; nacre salmon colored or purplish and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 156.

Hab.—Yadkin River, near Salisbury, North Carolina, C. M. Wheatley, Esq.

My cabinet, and cabinets of Mr. Wheatley and Dr. Hartman.

Diam. 1.1, Length 1.9, Breadth 3 inches.

Shell smooth, oblong, compressed, very inequilateral, flattened at the sides, subbiangular behind, rounded before; substance of the shell thick, very slightly thicker before; ligament rather large and dark brown; epidermis dark brown, without rays, slightly sulcate before and rugose behind, with very distant marks of growth; umbonial slope very obtusely angular; posterior slope carinate, narrow elliptical; cardinal teeth rather small, compressed, crenulate, corrugate and double in both valves; lateral teeth long, lamellar, corrugate and somewhat curved; anterior cicatrices distinct, large and well impressed; posterior cicatrices confluent, very large and slightly impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; ventral cicatrices very small; cavity of the shell rather shallow and wide; cavity of the beaks very shallow and rounded; nacre salmon colored or purplish and very iridescent.

Remarks.—Mr. Wheatley received quite a number of this species from the Yadkin River, and I owe to him a fine suite of them. It is of the *complanatus* group, but is not so wide as *complanatus*, and is higher on the umbonial slope. It differs from *planilateris* Con. from the same river in being less wide and having a very different epidermis. It is very near to *quadrilateris* and *humerosus* (nobis), but is less quadrate than the former and not so long as the latter. The remarkable character of possessing a ventral muscular attachment, leaving a small cicatrix, is worthy of notice. All the specimens before me have it more or less developed. The nacre of these specimens is salmon more or less deeply colored, except one, which is pale purplish. None of them have a white nacre. The beaks, being much eroded, present only the remains of undulations at the tips, very like those of *complanatus*.

UNIO CONASAUGAENSIS. Pl. 10, fig. 30.

Testa lævi, suboblonga, subinflata, inæquilaterali, postice subbiangulata, antice rotundata; valvulis percrassis, antice crassioribus; natibus subprominentibus; epidermide rufo-fusca, eradiata; dentibus cardinalibus parviusculis, subcompressis crenulatisque; lateralibus curtis, crassis, obliquis rectisque; margarita alba et aliquanto iridescente.

Shell smooth, rather oblong, somewhat inflated, inequilateral, subbiangular behind and rounded before; valves very thick, thicker before; beaks somewhat prominent; epidermis reddish-brown and without rays; cardinal teeth rather small, somewhat compressed and crenulate; lateral teeth short, thick, oblique and straight; nacre white and somewhat iridescent.

Proc. Acad. Nat. Sci., 1872, p. 155.

Hab.—Conasauga Creek, Monroe Co., East Tennessee, Miss A. E. Law.

My cabinet.

Diam. 1·1,

Length 1·6,

Breadth 2·5 inches.

Shell smooth, rather oblong, somewhat inflated, inequilateral, subbiangular behind, rounded before; substance of the shell thick, thicker before; beaks somewhat prominent; ligament large and dark brown; epidermis reddish-brown, roughened towards the margin, rayless, with rather close marks of growth; umbo-nial slope rounded; posterior slope narrow elliptical, with obscure indented lines; cardinal teeth rather small, somewhat compressed and crenulate, slightly disposed to be treble in the right valve; lateral teeth short, thick, oblique and straight; anterior cicatrices distinct, rather large and deeply impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices placed on the upper side of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks somewhat deep and obtusely angular; nacre white and somewhat iridescent.

Remarks.—Among a number of *Uniones* from East Tennessee a single specimen of this species was sent by Miss Law to Dr. Lewis. In outline it is very near to *subflavus* (nobis), but it is a stouter, more inflated species, may easily be distinguished by its having a rougher epidermis, more close marks of growth, and in being darker in the epidermis. The teeth also differ, being much smaller and thinner in *subflavus*. The beaks being eroded in the specimen under examination, the undulations cannot be described.

UNIO CONSPICUUS. Pl. 11, fig. 31.

Testa lævi, elliptica, subinflata, inæquilaterali, postice obtuse angulata, antice rotundata; valvulis crassis, antice crassioribus; natibus prominulis, ad apices undulatis; epidermide rufo-fusca, per-radiata; dentibus cardinalibus parviusculis, crenulatis, compresso-conicis, in utroque valvulo duplicibus; lateralibus prælongis, lamellatis, parum curvatis; margarita conspicua, persalmonia et formoso-iridescente.

Shell smooth, elliptical, somewhat inflated, inequilateral, obtusely angular behind and rounded before; valves thick, thicker before; beaks somewhat prominent, undulate at the tips; epidermis reddish-brown, radiate all over the disk; cardinal teeth rather small, crenulate, compressed conical, double in both valves; lateral teeth very long, lamellar and somewhat curved; nacre very bright, deep salmon colored and beautifully iridescent.

Proc. Acad. Nat. Sci., 1872, p. 156.

Hab.—Yadkin River, near Salisbury, North Carolina, C. W. Wheatley.

My cabinet and cabinets of C. M. Wheatley and Dr. Hartman.

Diam. 1·5, Length 2·5, Breadth 4·3 inches.

Shell smooth, elliptical, somewhat inflated, inequilateral, obtusely angular behind and rounded before; substance of the shell thick, thicker before; beaks somewhat prominent, undulate at the tips; ligament large and dark brown; epidermis reddish-brown, radiated all over the disks and with distant marks of growth; umbonial slope obtusely angular; posterior slope narrow elliptical, rough and dark in the adult; cardinal teeth rather small, crenulate, compressed conical and double in both valves; lateral teeth very long, lamellar and somewhat curved; anterior cicatrices distinct, very large and well impressed; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices placed within the cavity of the beaks; cavity of the shell rather deep and wide; cavity of the beaks rather shallow and obtusely angular; nacre very bright, deep salmon colored and beautifully iridescent.

Remarks.—This is another fine species obtained from North Carolina by Mr. Wheatley, to whom I am indebted for a fine suite. It is closely allied to *radiatus* Lam. Like it the rays are fine and usually cover the whole disk. The outline is very nearly the same. It is rather more inflated than the *radiatus* of the Delaware, Schuylkill and Susquehanna Rivers. It differs in the cardinal teeth being more compressed. The color of the nacre of all the specimens I have seen is of a very beautiful salmon. In some this color is intense.

UNIO BREVIS. Pl. 12, fig. 32.

Testa lævi, subtriangulari, subcompressa, ad latere subplanulata, inæquilaterali, postice obtuse biangulata, antice rotundata; valvulis crassiusculis, antice crassioribus; natibus prominulis; epidermide flavida, eradiata; dentibus cardinalibus parviusculis, subcompressis, in utroque valvulo duplicibus; lateralibus lamellatis, parviusculis obliquisque; margarita vel alba vel salmonis colore tineta et valde iridescente.

Shell smooth, subtriangular, somewhat compressed, flattish at the sides, inequilateral, obtusely biangular behind, rounded before; valves somewhat thick, thicker before; beaks somewhat prominent; epidermis yellowish and without rays; cardinal teeth rather small, subcompressed and double in both valves; lateral teeth rather small and oblique; nacre white or salmon colored and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 157.

Hab.—Conasauga Creek, Monroe Co., East Tennessee, Miss Law.

My cabinet and cabinets of Dr. Lewis and C. M. Wheatley.

Diam. ·6, Length 1·3, Breadth 1·9 inch.

Shell smooth, subtriangular, somewhat compressed, flattened at the sides, inequilateral, obtusely biangular behind, rounded before; substance of the shell somewhat thick, thicker before; beaks somewhat prominent; ligament rather short,

thick and dark brown; epidermis yellowish, without rays, with somewhat distant marks of growth; umbonial slope very obtusely biangular; posterior slope carinate, narrow elliptical, with an obscurely impressed line from the beaks to the posterior margin; cardinal teeth rather small, subcompressed and double in both valves; lateral teeth rather small and oblique; anterior cicatrices distinct, rather large and well impressed; posterior cicatrices distinct, rather large and well impressed; dorsal cicatrices placed above the centre; cavity of the shell shallow; cavity of the beaks obtusely angular and somewhat deep; nacre white or tinted with salmon color and very iridescent.

Remarks.—Two specimens were received by me from Dr. Lewis and Mr. Wheatley. Neither of the shells was perfect at the beaks. The character of the undulations of the tips is therefore unknown. In outline it is between *gibber* (nobis) and *rubiginosus* (nobis). Along the inferior margin the epidermis is somewhat rough and imbricate. One of the specimens before me has a few obsolete rays.

UNIO ANDERSONENSIS. Pl. 12, fig. 33.

Testa lævi, triangulari, inflata, ad latere planulata, emarginata, valde inæquilaterali, postice obtuse angulata, antice oblique rotundata; valvulis percrassis, antice crassioribus; natibus valde elevatis, tumidis recurvatisque; epidermide vel luteola vel fusca, obsolete radiata; dentibus cardinalibus crassis, crenulatis, conicis; lateralibus crassis, curtis subcurvisque; margarita argentea et iridescente.

Shell smooth, triangular, inflated, flattened at the sides, emarginate, very inequilateral, obtusely angular behind, obliquely rounded before; valves very thick, thicker before; beaks very much raised, swollen and recurved; epidermis yellowish or brownish, obscurely rayed; cardinal teeth thick, crenulate, conical; lateral teeth thick, short and somewhat curved; nacre silver white and iridescent.

Proc. Acad. Nat. Sci., 1872, p. 155.

Hab.—Holston River; and Clinch River, Anderson Co., East Tennessee, Miss A. E. Law.

My cabinet, and cabinet of Dr. Lewis.

Diam. 1·4,

Length 1·7,

Breadth 1·6 inch.

Shell smooth, triangular, inflated, flattened at sides, emarginate, very inequilateral, obtusely angular behind, obliquely rounded before; substance of the shell very thick, thicker before; beaks very much raised, swollen and recurved; ligament short, thick and chestnut brown; epidermis yellowish or brownish, obscurely rayed, with rather close marks of growth; umbonial slope obtusely angular; posterior slope cordate; cardinal teeth thick, crenulate, conical; lateral teeth very thick, short, somewhat curved and corrugate; anterior cicatrices distinct, rather small

and deeply impressed; posterior cicatrices very distinct and deeply impressed; dorsal cicatrices placed on the upper side of the cavity of the beaks; cavity of the shell rather deep and rounded; cavity of the beaks deep and obtusely angular; nacre silver-white and iridescent.

Remarks.—Among the specimens sent last season by Miss Law to Dr. Lewis was a single specimen, large for the species and well developed, but with beaks much eroded. During the present year (1871) Miss Law sent from Clinch River four other specimens, smaller but in better condition. The youngest is not quite one-third grown and has a bright polished, yellow epidermis nearly covered with delicate green rays; in this respect resembling *Edgarianus* (nobis). The three specimens of intermediate age are nearly of one size, have dark epidermis with a few very obscure rays on the umbones. The sides of the valves are so impressed as nearly to make a wide furrow, and this indenture causes the emargination of the basal margin. This species emphatically belongs to the *Edgarianus* group, but may be distinguished by its being more inflated, less rayed, and in having a less polished surface in the adults than *Edgarianus*. The specimen figured is the largest of the five.

UNIO VESICULARIS. Pl. 12, fig. 34.

Testa lævi, elliptica, inflata, valde inæquilaterali, postice et antice rotundata; valvulis crassiusculis, antice crassioribus; natibus prominulis; epidermide tenebroso-oliva, obsolete radiata; dentibus cardinalibus parvis, sulcatis, in utroque valvulo duplicibus; lateralibus sublongis, lamellatis subrectisque; margarita albida et valde iridescente.

Shell smooth, elliptical, inflated, very inequilateral, rounded behind and before; valves a little thick, thicker before; beaks slightly prominent; epidermis dark olive, obscurely rayed; cardinal teeth small, sulcate and double in both valves; lateral teeth rather long, lamellar and nearly straight; nacre whitish and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 156.

Hab.—Lake Ocheechobee, Florida, Dr. Budd and C. M. Wheatley.

My cabinet, and cabinet of Mr. Wheatley.

Diam. .5,

Length .7,

Breadth 1.3 inch.

Shell smooth, elliptical, inflated, very inequilateral, rounded behind and before; substance of the shell a little thick, thicker before; beaks slightly prominent; ligament rather long and thin; epidermis dark olive, obscurely rayed, with distant marks of growth; umbonial slope rounded; posterior slope narrow-elliptical; cardinal teeth small, sulcate, somewhat compressed and double in both valves; lateral teeth rather long, lamellar and nearly straight; anterior cicatrices distinct, small and well impressed; posterior cicatrices confluent, rather large and moderately

impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell rather deep and wide; cavity of the beaks shallow and obtusely angular; nacre whitish, rich and very iridescent.

Remarks.—Many years since I received from the late Dr. Budd of New York two opposing not well matched valves of this *Unio*. Both valves evidently belonged to females and both were much eroded. Not being entirely satisfied from imperfect odd valves that they belonged to an undescribed species, I placed them aside in the hope of getting others from Florida like them. The provided name *vesicularis* was placed on the label. Now after about twenty years my friend C. M. Wheatley, of Phoenixville, sends me a single smaller specimen from Lake Ocheechobee, which is evidently a male. The description and figure are made from this more perfect specimen. In outline it is very much the same with *parvus* Bar., but it is not so thick a species and the epidermis is lighter colored and is rayed. Neither of the specimens is perfect enough to exhibit the undulations of the beaks, which is much to be regretted, as this character might give us with certainty the key to the group in which it belongs.

UNIO CURVATUS. Pl. 13, fig. 35.

Testa lævi, late oblonga, subinflata, ad latere planulata, valde inæquilaterali, postice angulata, antice rotundata; valvulis parum crassis, antice crassioribus; natibus prominulis; epidermide tenebrososusca, aliquanto polita, eradiata; dentibus cardinalibus parvis, sulcatis, compressis, in utroque valvulo duplicibus; lateralibus longis, lamellatis subrectisque; margarita pallido salmonia vel purpurascens et valde iridescent.

Shell smooth, widely oblong, somewhat inflated, flattened at the sides, very inequilateral, angular behind, rounded before; valves somewhat thick, thicker before; beaks a little prominent; epidermis dark brown, somewhat polished, without rays; cardinal teeth small, sulcate, compressed, double in both valves; lateral teeth long, lamellar and nearly straight; nacre pale salmon color or purple and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 159.

Hab.—Pfeiffer's Pond, Mecklenberg Co., North Carolina, C. M. Wheatley.

My cabinet, and cabinet of C. M. Wheatley.

Diam. .7,

Length 1.1,

Breadth 2.4 inches.

Shell smooth, widely oblong, somewhat inflated, flattened on the sides, very inequilateral, angular behind, rounded before; substance of the shell somewhat thick, thicker before; beaks a little prominent, placed towards the anterior end; ligament long, thin and brown; epidermis dark brown, somewhat polished, without rays, with two or three distant marks of growth well developed; umbonial slope obtusely angular; posterior slope subcarinate, narrow elliptical; cardinal teeth small, sul-

cate, compressed, double in both valves; lateral teeth long, lamellar and nearly straight; anterior cicatrices distinct, large and well impressed; posterior cicatrices distinct, large and slightly impressed; dorsal cicatrices placed above the cavity of the beaks; cavity of the shell wide and very shallow; cavity of the beaks shallow and obtusely angular; nacre pale salmon color or purple and very iridescent.

Remarks.—Three specimens are before me by Mr. Wheatley's kindness. This species is allied to *virens* and *Catawbensis* (nobis), more so in outline to the latter, but it is rather wider and not so large a shell. It is not quite so flat on the sides as *Catawbensis*. None of the specimens were perfect enough to display the character of the undulations of the tips of the beaks.

UNIO AMPLUS. Pl. 13, fig. 36.

Testa lævi, oblonga, fere alata, inflata, inæquilaterali, postice obtuse biangulata, antice rotundata; valvulis crassis, antice crassioribus; natibus subprominentibus; epidermide rufo-fusca, nitida, obsolete radiata, transverse vittata; dentibus cardinalibus parviusculis, rugosis, compressis; laterilibus prælongis lamellatisque; margarita vel alba vel purpurea vel salmonis colore tincta et valde iridescente.

Shell smooth, oblong, almost winged, inflated, inequilateral, obtusely biangular behind, rounded before; valves thick, thicker before; beaks somewhat prominent; epidermis reddish-brown, shining, obscurely radiate and transversely banded; cardinal teeth rather small, rugose and compressed; lateral teeth very long and lamellar; nacre white, purple or salmon colored and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 157.

Hab.—Irwin's Creek, Mecklenberg Co., North Carolina, C. M. Wheatley.

My cabinet and cabinet of C. M. Wheatley.

Diam. 1·3, Length 2, Breadth 3·6 inches.

Shell smooth, oblong, almost winged, inflated, inequilateral, obtusely biangular behind, rounded before; substance of the shell thick, thicker before; beaks somewhat prominent; ligament rather long and somewhat thin; epidermis reddish-brown, shining, obscurely radiate and transversely banded, with rather distant marks of growth; umbonial slope obtusely angular; posterior slope carinate, elliptical, almost winged, with two slightly impressed lines from the beaks to the margin; cardinal teeth rather small, rugose and compressed; lateral teeth very long and lamellar; anterior cicatrices distinct, very large and well impressed; posterior cicatrices confluent, very large and moderately impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; nacre white, purple or salmon color.

Remarks.—Among the North Carolina shells sent to me by Mr. Wheatley, were four of this species. The largest of these is figured. The lines of growth are well

defined and on this specimen are five in number. It belongs to the group of *Raleighensis* (nobis), and may be placed between that species and *Abbevillensis*. It is larger than the latter and is higher in the wing than either. The beaks of all the specimens were too much eroded to give the character of the undulations of the tips.

UNIO INSOLIDUS. Pl. 13, fig. 37.

Testa lævi, oblonga, parum compressa, ad latere parum planulata, inæquilaterali, postice obtuse biangulari, antice rotundata; valvulis subtenuibus, antice parum crassioribus; natibus subprominentibus, ad apices undulatis; epidermide pallido-viridi, obsolete radiata; dentibus cardinalibus parvis, compressis; lateralibus longis, lamellatis rectisque; margarita alba et iridescente.

Shell smooth, oblong, somewhat compressed, slightly flattened at the sides, inequilateral, obtusely biangular behind, rounded before; valves rather thin, rather thicker before; beaks somewhat prominent, undulate at the tips; epidermis pale green, obscurely radiate; cardinal teeth small, compressed; lateral teeth long, lamellar and straight; nacre white and iridescent.

Proc. Acad. Nat. Sci., 1872, p. 159.

Hab.—Abbeville Dist., So. Car., Dr. Barratt; Fredericksburg, Va., Dr. Emmons; Irwin's Creek, Mecklenberg Co., North Carolina, C. M. Wheatley.

My cabinet and cabinet of C. M. Wheatley.

Diam. .7,

Length 1.3,

Breadth 2.3 inches.

Shell smooth, oblong, somewhat compressed, slightly flattened on the sides, inequilateral, obtusely biangular behind, rounded before; substance of the shell rather thin, thicker before; beaks somewhat prominent, undulate at the tips; ligament long, thin and light brown; epidermis pale green, obscurely radiate and with rather distant marks of growth; umbonial slope rounded; posterior slope carinate, narrow-elliptical, almost winged, with two green lines from the beaks to the margin; cardinal teeth small and compressed; lateral teeth long, lamellar and straight; anterior cicatrices confluent, rather large and very slightly impressed; posterior cicatrices confluent and scarcely perceptible; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks shallow and obtusely angular; nacre white and iridescent.

Remarks.—I have had three specimens of this shell many years from Dr. Barratt of Abbeville District, S. C. This species is so near to *U. decoratus* (nobis) in many characters, that I thought it might be merely a well-marked variety of that species. Having about thirty specimens from Mr. Wheatley taken in a more northern habitat of a different State, I do not hesitate to consider it distinct. It differs from *decoratus* in being more oblong and in having rather larger teeth.

The specimen from Virginia seems to be a male, while the others are generally females, judging from the enlargement of the umbonial slope.

UNIO ATTENUATUS. Pl. 14, fig. 38.

Testa lævi, lata, attenuata, ad latere subcompressa, valde inæquilaterali, postice subbiangulari, antice oblique rotundata; valvulis crassiusculis, antice parum crassioribus; natibus prominulis, fere terminalibus; epidermide tenebroso-fusca, aliquanto nigra, radiata; dentibus cardinalibus parvis, compressis, crenulatis, obliquis, in utroque valvulo-duplicibus; lateralibus prælongis, lamellatis subrectisque; margarita alba et valde iridescente.

Shell smooth, wide, attenuate, somewhat compressed at the sides, very inequilateral, subbiangular behind and obliquely rounder before; valves somewhat thick, slightly thicker before; beaks slightly prominent, nearly terminal; epidermis dark brown, somewhat blackish, radiated; cardinal teeth small, compressed, crenulate, oblique, double in both valves; lateral teeth very long, lamellar and nearly straight; nacre white and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 157.

Hab.—Savannah River, Geo., Dr. Barratt; and Beaver Creek, Houston Co., Geo., J. Lewis, M.D.

My cabinet and cabinet of Dr. Lewis.

Diam. .7,

Length 1,

Breadth 2.7 inches.

Shell smooth, wide, attenuate, somewhat compressed at the sides, very inequilateral, almost terminal, subbiangular behind and obliquely rounded before; substance of the shell somewhat thick, slightly thicker before; beaks slightly prominent; ligament long, thin and brown; epidermis dark brown, somewhat blackish, radiated, with very distant marks of growth; umbonial slope obtusely angular; posterior slope subcarinate, narrow elliptical; cardinal teeth small, compressed, crenulate, oblique, double in both valves; lateral teeth very long, lamellar, nearly straight; anterior cicatrices distinct, somewhat large and moderately impressed; posterior cicatrices confluent and slightly impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell wide and subcylindrical; cavity of the beaks shallow and obtusely angular; nacre white and very iridescent.

Remarks.—There are five specimens before me. That which is figured is from Beaver Creek, Geo. It is the most perfect and the whole disk is covered with small dark green rays. The old specimens are quite black and without rays. The nacre in all these is white and finely iridescent. None were perfect enough in the beaks to display undulations at the tips. It is very near in outline to *rostriformis* and *Hazlehurstianus* (nobis).

UNIO DIFFERTUS. Pl. 14, fig. 39.

Testa lævi, suboblonga, ventricosa, subæquilaterali, postice obtuse biangulari, fere rotunda, antice rotundata; valvulis crassis, antice crassioribus; natibus vix prominulis; epidermide subpolita, luteola et obsolete radiata; dentibus cardinalibus parvisculis, corrugatis, compressis et in utroque valvulo duplicibus; lateralibus longis, lamellatis subrectisque; margarita vel albida vel salmonis colore tineta et valde iridescente.

Shell smooth, suboblong, ventricose, subequilateral, obtusely biangular behind, almost round, rounded before; valves thick, thicker before; beaks scarcely prominent; epidermis somewhat polished, yellowish and obscurely radiated; cardinal teeth rather small, corrugate, compressed and double in both valves; lateral teeth long, lamellar and nearly straight; nacre salmon colored or white and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 158.

Hab.—Georgia? Major J. Le Conte.

My cabinet and cabinet of the Academy Natural Sciences.

Diam. 1·3, Length 1·7, Breadth 3·2 inches.

Shell smooth, elliptical, ventricose, subequilateral, obtusely biangular behind, almost round, rounded before; substance of the shell thick, thicker before; beaks scarcely prominent; ligament rather short and thick; epidermis somewhat polished, yellowish and obscurely radiated; umbonial slope rounded; posterior slope widely elliptical, subcarinate, with several impressed lines from the beaks to the margin; cardinal teeth rather small, corrugate, compressed and double in both valves; lateral teeth long, lamellar, nearly straight and enlarged at the posterior end; anterior cicatrices distinct, large and well impressed; posterior cicatrices confluent, large and moderately impressed; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell deep and wide; cavity of the beaks shallow and rounded; nacre light salmon colored or white and very iridescent.

Remarks.—Two specimens are before me. That which is figured is more inflated than the other and is probably a female. They came from the late Major Le Conte's collection, and although no habitat was attached to them, I have no doubt that they came from Georgia, as many of the new species given to me by him were from Liberty County of that State. The lines of growth are very distant. There are two specimens before me and these are moderately large and no doubt full grown. In outline *differtus* is near to *Savannahensis* (nobis), but differs in not having the side flattened and having a rounded umbonial slope. It is also near to *Cuvierianus* (nobis), but is not quite so oblique. One of the specimens, although eroded, shows imperfect undulations of the tips.

UNIO CUSPIDATUS. Pl. 14, fig. 40.

Testa lævi, lata, subinflata, ad latere parum curvata, valde inæquilaterali, postice cuspidata, subbiangulari, antice rotundata; valvulis crassiusculis; natibus prominulis, fere terminalibus; epidermide tenebroso-olivacea, eradiata, transverse vittata et polita; dentibus cardinalibus parvis, subcompressis, corrugatis, in utroque valvulo duplicibus; lateralibus longis, lamellatis subrectisque; margarita alba et valde iridescente.

Shell smooth, wide, somewhat inflated, somewhat curved at the side, very inequilateral, pointed behind, subbiangular, rounded before; beaks somewhat prominent, nearly terminal; epidermis dark olive, without rays, transversely banded and polished; cardinal teeth small, somewhat compressed, rough, double in both valves; lateral teeth long, lamellar and nearly straight; nacre white and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 159.

Hab.—Buckhead Creek, Burke Co., Geo., Bishop Elliott; and Abbeville Dist., South Carolina, Dr. Barratt.

My cabinet.

Diam. .7,

Length 1.3,

Breadth 2.7 inches.

Shell smooth, wide, somewhat inflated, somewhat curved at the side, very inequilateral, pointed and subbiangular behind, rounded before; beaks somewhat prominent and nearly terminal; ligament long, thin and light brown; epidermis dark olive, without rays, transversely banded, with rather close lines of growth and shining; umbonial slope rounded; posterior slope slightly carinate, narrow elliptical; cardinal teeth small, somewhat compressed, rough and double in both valves; lateral teeth long, lamellar and nearly straight; anterior cicatrices distinct, rather large and somewhat impressed; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices placed over the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks very shallow and rounded; nacre white and very iridescent.

Remarks.—Some years since, among the many new and fine species sent to me by the late Bishop Elliott, were two of the above described species, one of which is only half grown. The description was delayed in hopes of getting more specimens, which I had failed to do until two half-grown specimens came from Dr. Barratt. In outline it is near to *Barrattii* (nobis) and approaches that of *Burkensis* (nobis). It differs from the former in having a less pronounced umbonial slope, in having a thinner shell, less greenish and in being polished; also, in being rayless. In the color and polish of the epidermis it is like *Burkensis*, but it is wider in proportion, rather more inflated and more pronounced in the umbonial slope. It has also some resemblance to *naviculoides* (nobis). The lines of growth are rather close and well defined. The beaks are too much eroded in these specimens to display any character.

UNIO ROSTELLUM. Pl. 15, fig. 41.

Testa lævi, lata, compressa, ad latere planulata, valde inæquilaterali, postice obtuse biangulari, antice rotunda; valvulis tenuibus; natibus parvis; epidermide tenebroso-fusca, obsolete radiata; dentibus cardinalibus compressis, crenulatis, in utroque valvulo duplicibus; lateralibus prælongis, lamellatis rectisque; margarita vel albida vel purpurea et valde iridescente.

Shell smooth, wide, compressed, flattened at the sides, very inequilateral, obtusely biangular behind, round before; valves thin; beaks small; epidermis dark brown, obscurely rayed; cardinal teeth compressed, crenulate, double in both valves; lateral teeth very long, lamellar and straight; nacre white or purple and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 160.

Hab.—Macon, Georgia, J. C. Plant.

My cabinet, and cabinets of Mr. Plant and Mr. Wheatley.

Diam. .6,

Length 1,

Breadth 2.6 inches.

Shell smooth, wide, compressed, flattened at the sides, very inequilateral, obtusely biangular behind, round before; substance of the shell thin; beaks small; ligament rather long, thin and dark brown, obscurely rayed, with indistinct, rather distant marks of growth; umbonial slope obtusely angular; posterior slope slightly carinate, very much compressed, with impressed lines from the tips to the posterior margin; cardinal teeth compressed, crenulate, double in both valves; lateral teeth very long, lamellar and straight; anterior cicatrices distinct, large and slightly impressed; posterior cicatrices confluent, large and very slightly impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks scarcely perceptible; nacre white or purple and very iridescent.

Remarks.—Half a dozen specimens are before me, all of which were received from Mr. Plant long since. I have delayed describing it in hopes of getting better specimens, but have not succeeded. This species is near *rostriformis* (nobis), but it is not quite so acute. It is a smaller species and more compressed. The figure is probably from a female. It is near to *exacutus* (nobis), but is smaller and less solid. The beaks of all the specimens are much eroded, but there are remains which indicate a number of small undulations at the tips.

UNIO IRWINENSIS. Pl. 15, fig. 42.

Testa lævi, suboblonga, parum compressa, ad latere parum planulata, valde inæquilaterali, postice obtuse biangulari, antice rotundata; valvulis subcrassis, antice crassioribus; natibus prominulis, ad apices undulatis; epidermide olivacea vel fusca, obsolete radiata; dentibus cardinalibus subgrandibus, parum compressis, sulcosi, in utroque valvulo duplicibus; lateralibus longis, sublamellatis subcurvisque; margarita alba vel purpurea vel salmonis colore tincta et valde iridescente.

Shell smooth, somewhat oblong, rather compressed, somewhat flattened at the sides, very inequilateral, obtusely biangular behind, rounded before; valves rather thick, thicker before; beaks slightly prominent, undulate at the tips; epidermis olivaceous or brown, obscurely rayed; cardinal teeth rather large, somewhat compressed, sulcose and double in both valves; lateral teeth long, somewhat lamellar and slightly curved; nacre white, purple or salmon colored and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 159.

Hab.—Irwin's Creek, North Carolina, C. M. Wheatley.

My cabinet and cabinet of C. M. Wheatley.

Diam. 1, Length 1·8, Breadth 3·1 inches.

Shell smooth, somewhat oblong, rather compressed, somewhat flattened at the sides, very inequilateral, obtusely biangular behind, rounded before; substance of the shell rather thick, thicker before; beaks slightly prominent, undulate at the tips; ligament rather short, thick and brown; epidermis olivaceous or brown, obscurely rayed, with distinct and somewhat close marks of growth; umbonial slope raised and obtusely angular; posterior slope carinate, narrow elliptical; cardinal teeth rather large, somewhat compressed, sulcose and double in both valves; lateral teeth long, somewhat lamellar and slightly curved; anterior cicatrices distinct and deeply impressed; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell somewhat deep and wide; cavity of the beaks shallow; nacre white, purple or salmon colored and very iridescent.

Remarks.—Quite a number of specimens were sent to me by my friend Mr. Wheatley. In outline this species is near to *rufusculus* (nobis), but it is not so compact. Some specimens had ventral cicatrices and obscure rays. It reminds one of *Gastonensis* (nobis), but it is not so high in the wing.

UNIO EXACUTUS. Pl. 15, fig. 43.

Testa lævi, prælata, subcompressa, ad latere planulata, valde inæquilaterali, postice exacuta, subbiangulari, antice oblique rotundata; valvulis crassiusculis; natibus prominulis, fere terminalibus, ad apices minute undulatis; epidermide tenebroso-fusca, perradiata; dentibus cardinalibus parvis sulcatisque; lateralibus longis, rectis lamellatisque; margarita vel alba vel purpurea et valde iridescente.

Shell smooth, very wide, somewhat compressed, flattened at the sides, very inequilateral, pointed and subbiangular behind, obliquely rounded before; valves somewhat thick; beaks a little prominent, nearly terminal, minutely undulate at the tips; epidermis dark brown, very much rayed; cardinal teeth small and sulcate; lateral teeth long, straight and lamellar; nacre white or purple and very iridescent.

Shell smooth, oblong, somewhat compressed, flattened at the sides, inequilateral, subbiangular behind, rounded before; substance of the shell rather thick, slightly thicker before; beaks a little prominent, at the tips concentrically and roughly wrinkled; ligament rather large and dark brown; epidermis dark brown, shining and radiate; umbonial slope somewhat raised and obtusely angular; posterior slope carinate and rather narrow-elliptical; cardinal teeth rather small, conical, rugose and somewhat double in both valves; lateral teeth very long, lamellar and somewhat curved; anterior cicatrices distinct, large and rather deeply impressed; posterior cicatrices confluent, rather large and slightly impressed; dorsal cicatrices placed in the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks shallow and rounded; nacre salmon colored and very iridescent.

Remarks.—I have four specimens before me. This species is nearly allied to *Catawbensis* and *rufusculus* (nobis). It is not so wide as the former, but is higher in the wing. All four are salmon colored. The old ones have no rays remaining; the younger are full of obscure rays. In outline it is near to *Irwinensis* described herein, but it is more compressed and has more distant marks of growth. It reminds one of *nubilus* (nobis) and is close to it in outline. None were perfect at the tips.

UNIO SUBSQUAMOSUS. Pl. 16, fig. 45.

Testa lævi, oblongo-elliptica, compressa, ad latere subplanulata, valde inæquilaterali, postice obtuse biangulari, antice oblique rotundata; valvulis crassiusculis; natibus parvis, prominulis, ad apices rugoso-undulatis; epidermide tenebroso-fusca, subsquamosa, eradiata; dentibus cardinalibus parvis, sulcatis, in utroquo valvulo duplicibus; lateralibus prælongis, lamellatis subrectisque; margarita alba et valde iridescente.

Shell smooth, oblong-elliptical, compressed, somewhat flattened at the sides, very inequilateral, obtusely biangular behind, obliquely rounded before; valves somewhat thick; beaks small, a little prominent, rugosely undulate at the tips; epidermis dark brown, somewhat squamose, without rays; cardinal teeth small, sulcate, double in both valves; lateral teeth very long, lamellar and nearly straight; nacre white and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 160.

Hab.—Yadkin River, North Carolina, C. M. Wheatley.

My cabinet and cabinet of C. M. Wheatley.

Diam. .8, Length 1.5, Breadth 3.1 inches.

Shell smooth, oblong-elliptical, compressed, somewhat flattened at the sides, very inequilateral, obtusely biangular behind, obliquely rounded before; substance

of the shell somewhat thick; beaks small, a little prominent and rugosely undulate at the tips; ligament rather long, narrow and dark brown; epidermis dark brown, somewhat squamose, without rays, with distant and well-marked lines of growth; umbonial slope very slightly raised and obtusely angular; posterior slope slightly carinate and very narrow elliptical; cardinal teeth small, sulcate, compressed conical and double in both valves; lateral teeth very long, lamellar and nearly straight; anterior cicatrices distinct, very large and well impressed; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks scarcely observable; nacre white and very iridescent.

Remarks.—Mr. Wheatley has furnished me with seven specimens of this species. In outline it is nearest to *rostrum* (nobis). It is somewhat squamose like *squameus* (nobis), but it differs in outline and the beaks are more medial. There is a strong disposition to sulcation on the exterior, particularly on the anterior portion of the valve.

UNIO BASALIS. Pl. 16, fig. 46.

Testa lævi, oblonga, subinflata, ad latere subplanulata, inæquilaterali, postice obtuse biangulari, antice rotundata, ad basim recta; valvulis crassiusculis; natibus prominulis; epidermide luteola, radiata; dentibus cardinalibus parviusculis, subcompressis, sulcatis; lateralibus sublongis, lamellatis curvisque; margarita vel albida vel purpurascente et iridescente.

Shell smooth, oblong, somewhat inflated, flattened at the sides, inequilateral, obtusely biangular behind, rounded before, straight at the base; valves somewhat thick; beaks a little prominent; epidermis yellowish and radiate; cardinal teeth rather small, rather compressed, sulcate; lateral teeth rather long, lamellate and curved; nacre white or purple and iridescent.

Proc. Acad. Nat. Sci., 1872, p. 161.

Hab.—Carter's Creek, near Columbus, Georgia, G. Hallenbeck.

My cabinet.

Diam. .8,

Length 1.5,

Breadth 2.5 inches.

Shell smooth, oblong, somewhat inflated, flattened at the sides, inequilateral, obtusely biangular behind, rounded before, straight at the base; substance of the shell somewhat thick; beaks a little prominent; ligament short, thick and dark brown; epidermis yellowish, rayed, with rather close marks of growth; umbonial slope raised and rounded; posterior slope carinate, narrow elliptical; cardinal teeth rather small, somewhat compressed and sulcate; lateral teeth rather long, lamellar and curved; anterior cicatrices distinct, rather small and well impressed; posterior cicatrices confluent, large and moderately well impressed; dorsal cicatrices placed

nearly in the centre of the cavity of the beaks; cavity of the shell rather deep; cavity of the beaks very small; nacre white or purple and very iridescent.

Remarks.—A single mature and several young specimens are before me. In outline it is near to *neglectus* (nobis), but it is more oblong and not ventricose. The tips of neither of the specimens are perfect enough to observe the character of the undulations. The specimen figured is evidently a female.

UNIO LIGATUS. Pl. 17, fig. 47.

Testa lævi, ovato-oblonga, subcompressa, inæquilaterali, postice obscure biangulari, antice rotundata; valvulis subcrassis; natibus prominulis; epidermide tenebroso-fusca, polita, obsolete radiata, transverse vittata; dentibus cardinalibus parviusculis, corrugatis et in utroque valvulo duplicibus; lateralibus longis, lamellatis, corrugatis subcurvisque; margarita vel alba vel salmonis colore tincta et valde iridescente.

Shell smooth, ovately oblong, somewhat compressed, inequilateral, obscurely biangular behind, rounded before; valves rather thick; beaks rather prominent; epidermis dark brown, polished, obscurely radiate and transversely banded; cardinal teeth rather small, corrugate and double in both valves; lateral teeth long, lamellar, corrugate and somewhat curved; nacre white or salmon colored and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 157.

Hab.—Irwin's Creek, Mecklenburg Co., and Long Creek, Gaston Co., N. C., C. M. Wheatley.

My cabinet and cabinet of Mr. Wheatley.

Diam. .8, Length 1.6, Breadth 2.8 inches.

Shell smooth, ovately oblong, somewhat compressed, inequilateral, obscurely biangular behind, rounded before; substance of the shell rather thick; beaks rather prominent; ligament rather long, thin and dark brown; epidermis dark brown, polished, obscurely radiate and transversely banded, with distant marks of growth; umbonal slope rounded; posterior slope subcarinate, narrow elliptical, with obscure impressed lines from the beaks to the posterior margin; cardinal teeth rather small, corrugate, crenulate and double in both valves; lateral teeth long, lamellar, corrugate and somewhat curved; anterior cicatrices distinct, large and well impressed; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices small and placed above the centre of the cavity of the beaks; cavity of the shell shallow and wide; cavity of the beaks shallow and curved; nacre white or salmon colored and very iridescent.

Remarks.—Specimens of this species were sent to me by Mr. Wheatley, to whom I am obliged for many new and interesting *Uniones* from North Carolina.

The well defined transverse bands of the marks of growth are more developed than usual, and the obscure capillary rays over the whole disk are unusual. The nacre is generally of a fine salmon color, sometimes it is white. None of the specimens before me are purplish, nor were they perfect enough to display the character of the tips of the beaks. This species belongs to the group of which *Abbevillensis* may be considered the type. That species has not the smooth polished epidermis which *ligatus* has.

UNIO BELLULUS. Pl. 17, fig. 48.

Testa lævi, obliqua, tumida, ad latere parum planulata, valde inæquilaterali, postice obtuse angulari, antice oblique rotundata; valvulis percrassis, antice crassioribus; natibus pyramidatis, fere terminalibus; epidermide luteola, valde radiata; dentibus cardinalibus subcrassis, rugosis; lateralibus curtis, crassis rugosisque; margarita argentea et valde iridescente.

Shell smooth, oblique, tumid, somewhat flattened at the side, very inequilateral, obtusely angular behind, obliquely rounded before; valves very thick, thicker before; beaks pyramidal, nearly terminal; epidermis yellowish, very much rayed; cardinal teeth rather thick and rugose; lateral teeth short, thick and rugose; nacre silver white and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 161.

Hab.—Holston River, Dr. Edgar; Tennessee River, Rev. G. White; Mussel Shoals, Tennessee River, Alabama, C. M. Wheatley.

My cabinet and cabinet of C. M. Wheatley.

Diam. .9,

Length 1.2,

Breadth 1.3 inch.

Shell smooth, oblique, tumid, somewhat flattened at the sides, very inequilateral, obtusely angular behind, obliquely rounded before; substance of the shell very thick, thicker before; beaks pyramidal, nearly terminal; ligament short and light brown; epidermis yellowish, with broad interrupted green rays and somewhat distant marks of growth; umbonial slope rounded; posterior slope cordate, yellow, with two dotted rays from the beak to posterior margin in each valve; cardinal teeth rather thick and rugose; lateral teeth short, thick, rugose and very oblique; anterior cicatrices distinct, small and deeply impressed; posterior cicatrices distinct and well impressed; dorsal cicatrices placed nearly over the centre of the cavity of the beaks; cavity of the shell rather deep and rounded; cavity of the beaks deep and obtusely angular; nacre silver white and very iridescent.

Remarks.—Several specimens of different ages are before me. Some of middle age I have had for many years. The adult from Mr. Wheatley, recently received, satisfied me that the species was undescribed. The beautiful broad green inter-

rupted rays nearly cover the whole disk. This species is nearly allied to *mundus* and *Lawii* (nobis), but is not so oblique as either. None of the specimens had the beaks perfect enough to present the character of the tips.

UNIO INFUSCUS. Pl. 17, fig. 49.

Testa lævi, elliptica, subinflata, inæquilaterali, postice obtuse biangulari, antice rotundata; valvulis crassis, antice crassioribus; natibus prominulis, ad apices parum undulatis; epidermide tenebrososusca, submicanti, obsolete radiata; dentibus cardinalibus subcrassis, compressis corrugatisque; lateralibus longis, lamellatis, rugosis subcurvisque; margarita vel salmonia vel purpurascens et valde iridescente.

Shell smooth, elliptical, somewhat inflated, inequilateral, obtusely biangular behind, rounded before; valves thick, thicker before; beaks somewhat prominent, slightly undulate at the tips; epidermis dark brown, somewhat shining, obscurely radiate; cardinal teeth somewhat thick, compressed and corrugate; lateral teeth long, lamellar, rugose and somewhat curved; nacre salmon colored or purple and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 160.

Hab.—Fox River and Irwin's Creek, North Carolina, C. M. Wheatley.

My cabinet and cabinet of Mr. Wheatley.

Diam. .9, Length, 1.5, Breadth 2.8 inches.

Shell smooth, elliptical, somewhat inflated, inequilateral, obtusely biangular behind, rounded before; substance of the shell thick, thicker before; beaks somewhat prominent, slightly undulate at the tips; ligament rather large and dark brown; epidermis dark brown, somewhat shining, obscurely radiate, with very distant marks of growth; umbonial slope obtusely angular; posterior slope narrow-elliptical, carinate, with two indistinct impressed lines from beaks to margin; cardinal teeth somewhat thick, compressed and corrugate; lateral teeth long, lamellar, rugose and somewhat curved; anterior cicatrices distinct, large and well impressed; posterior cicatrices distinct, large and slightly impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell rather shallow and wide; cavity of the beaks shallow and rounded; nacre salmon colored or purple and very iridescent.

Remarks.—Many specimens of various ages were received from Mr. Wheatley. The younger showed small undulations at the tips. The nacre generally salmon color, some of them quite brilliant; some were purplish, none white. The rays on the more perfect specimens are capillary; on the old specimens they are obsolete. This species is nearly allied to *ligatus* herein described, but it is more transverse, with more distant bands and is higher on the umbonial slope.

UNIO OBLONGUS. Pl. 18, fig. 50.

Testa lævi, oblonga, compressa, ad latere planulata, valde inæquilaterali; postice obtuse biangulari, antice rotundata; valvulis parum crassioribus; natibus prominulis; epidermide luteola, micanti, radiata vel eradiata; dentibus cardinalibus parvis, lobatis, corrugatis, in utroque valvulo duplicibus; lateralibus prælongis subrectisque; margarita alba vel purpurascenti vel salmonis colore tincta et iridescente.

Shell smooth, oblong, compressed, flattened at the sides, very inequilateral; obtusely biangular behind, rounded before; valves somewhat thick; beaks a little prominent; epidermis yellowish, shining, radiated or without rays; cardinal teeth small, lobed, corrugate, double in both valves; lateral teeth very long and straight; nacre white, purple or salmon color and iridescent.

Proc. Acad. Nat. Sci., 1872, p. 158.

Hab.—Irwin's Creek, North Carolina, C. M. Wheatley.

My cabinet and cabinet of C. M. Wheatley.

Diam. .9,

Length 1.4,

Breadth 3 inches.

Shell smooth, oblong, compressed, flattened at the sides, very inequilateral; obtusely biangular behind, rounded before; substance of the shell somewhat thick; beaks a little prominent; ligament long, somewhat thick and brown; epidermis yellowish, radiated or without rays and with distant marks of growth; umbonial slope rounded; posterior slope carinate; cardinal teeth small, lobed, double in both valves; lateral teeth very long and straight; anterior cicatrices distinct, large and well impressed; posterior cicatrices distinct, large and moderately impressed; dorsal cicatrices placed over the centre of the cavity of the beaks; cavity of the shell very shallow and wide; cavity of the beaks very small and wide; nacre white, purple or salmon color and iridescent.

Remarks.—I have several specimens of this species, but none perfect enough in the beaks to give the character of the tips. Some have a few rays; generally they were without rays, the prevailing character of the epidermis being yellowish. All the specimens but two had white nacre: one was purple and one salmon colored. This species is nearly allied to *Raënsis* and *aberrans* (nobis), also to *subparallelus* herein described.

UNIO RATUS. Pl. 18, fig. 51.

Testa lævi, quadrata, subcompressa, ad latere subplanulata; valde inæquilaterali, postice obtuse angulata, antice rotunda; valvulis subcrassis, antice crassioribus; natibus prominulis; epidermide tenebroso-olivacea, eradiata; dentibus cardinalibus parvis, subconicis, sulcosi, in utroque valvulo duplicibus; lateralibus sublongis, lamellatis subcurvisque; margarita purpurascens et valde iridescente.

Shell smooth, quadrate, somewhat compressed, slightly flattened at the sides; very inequilateral, obtusely angular behind, rounded before; valves somewhat thick, thicker before; beaks somewhat prominent; epidermis dark olive, without rays; cardinal teeth small, subconical, sulcate and double in both valves; lateral teeth rather long and somewhat curved; nacre purplish and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 160.

Hab.—Neuse River, North Carolina, Prof. E. Emmons.

My cabinet.

Diam. .8, Length 1.2, Breadth 2.2 inches.

Shell smooth, quadrate, somewhat compressed, slightly flattened at the sides, very inequilateral, obtusely angular behind and rounded before; substance of the shell somewhat thick, slightly thicker before; beaks somewhat prominent; ligament rather thin and dark brown; epidermis dark olive, without rays and with distant marks of growth; umbonial slope obtusely angular; posterior slope subcarinate and narrow elliptical; cardinal teeth small, subconical, sulcate and double in both valves; lateral teeth rather long, lamellate and somewhat curved; anterior cicatrices distinct, well impressed and corrugate; lateral cicatrices confluent, large, indistinct; dorsal cicatrices placed over the centre of the cavity of the beaks; cavity of the shell not deep; cavity of the beaks scarcely perceptible; nacre purplish and very iridescent.

Remarks.—A single specimen was received a long time since from Dr. Emmons. The description has been deferred with the hope of other and better specimens being found. The beaks being eroded, the character of the tips cannot be observed. In outline it is near to *hebes* (nobis), but it is not so high on the carina. It reminds one of *subgibbosus* (nobis).

UNIO DISSIMILIS. Pl. 18, fig. 52.

Testa lævi, sublata, compressa, ad latere planulata, valde inæquilaterali, postice obtuse angulari, antice rotunda; valvulis subtenuibus; natibus prominulis; epidermide tenebroso-fusca, micanti, eradiata; dentibus cardinalibus parviusculis, subcompressis, sulcosi, in utroque valvulo duplicibus; lateralibus prælongis, lamellatis subrectisque; margarita alba et valde iridescente.

Shell smooth, rather wide, compressed, flattened at the sides, very inequilateral, obtusely angular behind, round before; valves rather thin; beaks slightly prominent; epidermis dark brown, shining, without rays; cardinal teeth rather small, somewhat compressed, sulcose, double in both valves; lateral teeth very long, lamellar and nearly straight; nacre white and very iridescent.

Proc. Acad. Nat. Sci., 1872, p. 161.

Hab.—Long Creek, Gaston Co., and Pfeiffer's Pond, Mecklenburg Co., North Carolina, C. M. Wheatley.

My cabinet and cabinet of C. M. Wheatley.

Diam. .8,

Length 1.5,

Breadth 3.1 inches.

Shell smooth, rather wide, compressed, flattened at the sides, very inequilateral, obtusely angular behind, round before; substance of the shell rather thin, slightly thicker before; beaks slightly prominent; ligament long, somewhat thick and light brown; epidermis dark brown, shining, without rays, with rather close marks of growth; umbonial slope rounded; posterior slope narrow elliptical, with indistinct lines from the tips of the beaks to the margin; cardinal teeth rather small, somewhat compressed, sulcose and double in both valves; lateral teeth very long, lamellar and nearly straight; anterior cicatrices distinct, large and moderately impressed; lateral cicatrices confluent, large and slightly impressed; dorsal cicatrices placed over the centre of the cavity of the beaks; cavity of the shell very shallow and wide; cavity of the beaks scarcely observable; nacre white and iridescent.

Remarks.—Neither of the six specimens before me has beaks perfect enough to exhibit the undulations of the tips. In outline it is near to *viridiradiatus* (nobis), but it is wider and more flat. It is also in outline near to *pullatus* (nobis), but is not so thick in the valves, while it is more compressed.

SUPPLEMENT

TO

ISAAC LEA'S PAPER ON UNIONIDÆ.

UNIO CIRRATUS. Pl. 19, fig. 53.

Testa lævi, oblonga, subcompressa, inæquilaterali, postice obtuse biangulari, antice rotunda; valvulis subcrassis, antice parum crassioribus; natibus prominulis; epidermide tenebroso-fusca, subcirrata, eradiata; dentibus cardinalibus parviusculis, sulcatis, in utroque valvulo duplicibus; lateralibus sublongis, lamellatis subrectisque; margarita vel alba vel salmonis colore tineta et valde iridescente.

Shell smooth, oblong, somewhat compressed, inequilateral, obtusely biangular behind, round before; valves somewhat thick, a little thicker before; beaks a little prominent; epidermis dark brown, somewhat roughened, without rays; cardinal teeth rather small, sulcate, double in both valves; lateral teeth rather long, lamellar and nearly straight; nacre white or salmon colored and very iridescent.

Proc. Acad. Nat. Sci., 1873, p. 422.

Hab.—Abbeville District, South Carolina, Dr. J. P. Barratt.

My cabinet and cabinet of C. M. Wheatley.

Diam. 1·1,

Length 1·8,

Breadth 3·2 inches.

Shell smooth, oblong, somewhat compressed, inequilateral, obtusely biangular behind, round before; substance of the shell somewhat thick, a little thicker before; beaks a little prominent; ligament rather large and dark brown; epidermis dark brown, somewhat roughened, without rays and with rather close marks of growth; umbonial slope somewhat raised and rounded; posterior slope subcarinate, elliptical; cardinal teeth rather small, sulcate and double in both valves; lateral teeth rather long, lamellar and nearly straight; anterior cicatrices distinct, large and well impressed; posterior cicatrices confluent, large and moderately impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell rather deep and wide; cavity of the beaks shallow and rounded; nacre white or salmon color and very iridescent.

Remarks.—This species is closely allied to *Abbevillensis* (nobis), and is from the same locality. For a long time I thought it a variety of that species, but by addi-

tional specimens I am satisfied that it is distinct. It may be distinguished by its being more quadrate, of a darker epidermis, and having the marks of growth much more close. None of these specimens have the beaks sufficiently perfect to display the undulations of the tips.

UNIO HASTATUS. Pl. 19, fig. 54.

Testa lævi, transversa, subcompressa, valde inæquilaterali, postice angulata, antice rotunda; valvulis crassiusculis, antice parum crassioribus; natibus prominulis; epidermide luteo-oliva, obsolete radiata; dentibus cardinalibus parvis, subcompressis crenulatisque; lateralibus longis, lamellatis subrectisque; margarita alba et valde iridescente.

Shell smooth, transverse, somewhat compressed, very inequilateral, angular behind and round before; valves somewhat thick, slightly thicker before; beaks slightly raised; epidermis yellowish-olive, obscurely rayed; cardinal teeth small, somewhat compressed and crenulate; lateral teeth long, lamellar and nearly straight; nacre white and very iridescent.

Proc. Acad. Nat. Sci., 1873, p. 423.

Hab.—New-Market, Abbeville District, South Carolina, Dr. L. R. Gibbs and Dr. J. P. Barratt; Rocky Creek, near Macon, Georgia, J. C. Plant.

My cabinet.

Diam. .6,

Length 1.1,

Breadth 2.5 inches.

Shell smooth, transverse, somewhat compressed, very inequilateral, angular behind, round before; substance of the shell somewhat thick, slightly thicker before; beaks slightly raised; ligament long, thin and light brown; epidermis yellowish-olive, obscurely rayed, with distant marks of growth; umbonial slope very slightly raised and rounded; posterior slope narrow elliptical, slightly carinate; cardinal teeth small, somewhat compressed and crenulate; lateral teeth long, lamellar and nearly straight; anterior cicatrices distinct, rather large and somewhat impressed; posterior cicatrices confluent, large and slightly impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell wide and very shallow; cavity of the beaks very shallow; nacre white and very iridescent.

Remarks.—Many years since I received two specimens of this species from Prof. Gibbs, and shortly afterwards a single valve from the late Dr. Barratt.

I was greatly in hopes of getting more and better specimens, but none have been observed, to my knowledge. The outline is somewhat like that of *Barrattii* (nobis), but that species is not so transverse, is darker in the epidermis and has more rays. It is also a straighter shell. It properly comes between *Barrattii* and *productus* Con. It cannot be confounded with the latter shell. Neither specimen has beaks perfect enough to display any undulations of the tips.

UNIO STRUMOSUS. Pl. 19, fig. 55.

Testa lævi, rotundata, inflata, inæquilaterali, postice obtuse angulata, antice rotundata; valvulis crassis; natibus prominulis; epidermide tenebroso-fusca vel nigra, eradiata; dentibus cardinalibus subgrandibus, rugosis, in utroque valvulo duplicibus; lateralibus longis, rugosis curvatisque; margarita alba et iridescente.

Shell smooth, rounded, inflated, inequilateral, obtusely angular behind, rounded before; valves thick; beaks a little prominent; epidermis dark brown or black, without rays; cardinal teeth rather large, rugose, double in both valves; lateral teeth long, rugose and curved; nacre white and iridescent.

Proc. Acad. Nat. Sci., 1873, p. 423.

Hab.—Yadkin River, North Carolina, C. M. Wheatley.

My cabinet and cabinet of Mr. Wheatley.

Diam. 1, Length 1·7, Breadth 2·6 inches.

Shell smooth, rounded, inflated, inequilateral, obtusely angular behind, rounded before; substance of the shell thick; beaks a little prominent; ligament large and dark brown; epidermis dark brown or black, without rays, with distant marks of growth; umbonial slope obtusely angular; posterior slope somewhat raised and narrow elliptical; cardinal teeth rather large, rugose and double in both valves; lateral teeth long, lamellar, rugose and curved; anterior cicatrices distinct, rather large and well impressed; lateral cicatrices confluent and large; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell rather large and somewhat deep; cavity of the beaks rather deep and obtusely angular; nacre white and iridescent.

Remarks.—The three specimens before me are all white. One has a slight tint of salmon color. Others may be found purple or deep salmon. Neither of these specimens is in good condition, and the beaks being much eroded there is no indication of the undulations of the tips. In outline it is allied to *rotundatus* Lam., but cannot be confounded with that species.

UNIO SUBOLIVACEUS. Pl. 20, fig. 56.

Testa lævi, oblonga, subcompressa, inæquilaterali, postice obtuse angulari, antice rotundata; valvulis crassis, antice parum crassioribus; natibus prominulis; epidermide luteo-olivacea, subnitida, eradiata; dentibus cardinalibus grandis, sulcatis, in utroque valvulo duplicibus; lateralibus percrassis obliquisque; margarita alba et iridescente.

Shell smooth, oblong, somewhat compressed, inequilateral, obtusely angular behind and rounded before; valves thick, rather thicker before; beaks slightly

prominent; epidermis yellowish-olive, somewhat shining, without rays; cardinal teeth large, sulcate, double in both valves; lateral teeth very thick and oblique; nacre white and iridescent.

Proc. Acad. Nat. Sci., 1873, p. 422.

Hab.—Catawba River, Fox and Yadkin Rivers, N. Carolina, C. M. Wheatley.

My cabinet and cabinet of Mr. Wheatley.

Diam. 1·1, Length 1·7, Breadth 2·7 inches.

Shell smooth, oblong, somewhat compressed, inequilateral, obtusely angular behind, rounded before; substance of the shell thick, rather thicker before; beaks slightly prominent; ligament short, thick and light brown; epidermis yellowish-olive, somewhat shining, without rays and with rather distant marks of growth; umbonial slope raised and obtusely angular; posterior slope subcarinate, elliptical, with impressed lines from the beaks to the posterior margin; cardinal teeth large, sulcate, double in both valves; lateral teeth very thick, corrugate and oblique; anterior cicatrices distinct, large and well impressed; posterior cicatrices confluent, large and moderately impressed; dorsal cicatrices placed above the centre of the cavity of the beaks; cavity of the shell rather deep and wide; cavity of the beaks rounded; nacre white and iridescent.

Remarks.—I have eight specimens before me from different habitats. All have a pale olivaceous epidermis. In outline and general character it is closely allied to *U. Savannahensis* (nobis). It is rather smaller, more compressed, and differs in the color of the epidermis. None have beaks perfect enough to exhibit the character of the tips.

UNIO SUBCYLINDRACEUS. Pl. 20, fig. 57.

Testa lævi, valde transversa, subcylindræa, valde inæquilaterali, postice obtuse biangulari, antice oblique rotundata; valvulis crassis, antice parum crassioribus; natibus prominulis; epidermide luteo-viridi, perradiata; dentibus cardinalibus subparvis, compresso-conicis crenulatisque; lateralibus prælongis, lamellatis subrectisque; margarita vel alba vel purpurea vel salmonia coloris tincta et valde iridescente.

Shell smooth, very transverse, subcylindrical, very inequilateral, obtusely biangular behind, obliquely rounded before; valves thick, somewhat thicker before; beaks a little prominent; epidermis yellowish-green, much radiated; cardinal teeth rather small, compressed conical and crenulate; lateral teeth very long, lamellar and nearly straight; nacre white, purple or salmon colored and very iridescent.

Proc. Acad. Nat. Sci., 1873, p. 422.

Hab.—Rocky Creek, near Macon, Georgia, J. C. Plant; and Carter's Creek, Georgia, J. Postell.

My cabinet, and cabinet of J. C. Plant.

Diam. 1·1, Length 1·6, Breadth 3·8 inches.

Shell smooth, very transverse, subcylindrical, very inequilateral, obtusely biangular behind, obliquely rounded before; substance of the shell thick, somewhat thicker before; beaks a little prominent; ligament long, rather thick and light brown; epidermis yellowish-green, much radiated and with rather distant marks of growth; umbonial slope very obtusely angular; posterior slope scarcely raised, narrow elliptical, with two impressed lines in each valve from the beaks to the posterior margin; anterior cicatrices distinct, rather large and well impressed; posterior cicatrices confluent and well impressed; dorsal cicatrices placed above the cavity of the beaks; cavity of the shell wide and somewhat deep; cavity of the beaks very shallow, scarcely observable; nacre white, purple or salmon color and very iridescent.

Remarks.—There are four specimens before me, all of different ages. Three are from Mr. Plant and one, the youngest, from Mr. Postell. None of them are perfect enough to present the undulations of the beaks. In outline it is nearest to *exacutus* (nobis), but it is a stouter species and not quite so transverse.

UNIO CORNEUS. Pl. 20, fig. 58.

Testa lævi, oblonga, subcompressa, ad latere parum planulata, inæquilaterali, postice biangulari, antice rotundata; valvulis crassiusculis; natibus prominulis; epidermide cornea, perradiata; dentibus cardinalibus crassiusculis et in utroque valvulo duplicibus; lateralibus longis, crassis subcurvisque; margarita pallido-purpurea vel salmonis colore tineta et iridescente.

Shell smooth, oblong, somewhat compressed, at the side slightly flattened, inequilateral, biangular behind and rounded before; valves somewhat thick; beaks slightly prominent; epidermis horn color, very much radiated; cardinal teeth somewhat thick and double in both valves; lateral teeth long, thick and somewhat curved; nacre pale purple or salmon and iridescent.

Proc. Acad. Nat. Sci., 1873, p. 423.

Hab.—Columbus, Georgia, G. Hallenbeck; Abbeville District, South Carolina, Dr. Barratt; Marietta, Georgia, J. C. Anthony.

My cabinet and cabinet of Mr. Anthony.

Diam. ·8, Length 1·4, Breadth 2·1 inches.

Shell smooth, oblong, somewhat compressed, at the side slightly flattened, inequilateral, biangular behind and rounded before; substance of the shell somewhat thick; beaks slightly prominent; ligament rather long, narrow and light brown; epidermis horn color, nearly covered with green rays, with rather distant marks of

growth; umbonial slope very slightly raised and obtusely angular; posterior slope carinate, narrow elliptical, with two green rays in each valve; cardinal teeth somewhat thick, corrugate and double in both valves; lateral teeth long, thick and somewhat curved; anterior cicatrices distinct, rather small and well impressed; posterior cicatrices confluent, rather large and slightly impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell shallow; cavity of the beaks very shallow and rounded; nacre pale purple or salmon and iridescent.

Remarks.—I have had several specimens of this species in my possession for some years. Only one, which is figured, seems to be full grown. It is closely allied to *Abbevillensis* (nobis) and I have had doubts of its being more than a variety, but the specimens subsequently received have satisfied me as to its being distinct. While nearly of the outline of *Abbevillensis* it differs in not being so yellow in the epidermis, and in being usually covered with green capillary rays. It is devoid of the strong marks of growth which are so remarkable in that species. None of the specimens had perfect beaks—therefore the undulations are not known.

UNIO INFULGENS. Pl. 21, fig. 59.

Testa lævi, suboblonga, inflata, inæquilaterali, postice subbiangulari, antice rotundata; valvulis crassis, antice parum crassioribus; natibus prominulis; epidermide nitida, polita, eradiata; dentibus cardinalibus subgrandibus, sulcatis et in utroque valvulo duplicibus; lateralibus longis, crassis subrectisque; margarita salmonis colore tineta et valde iridescente.

Shell smooth, suboblong, inflated, inequilateral, subbiangular behind, rounded before; valves thick, rather thicker before; beaks slightly prominent; epidermis bright, polished and without rays; cardinal teeth rather large, sulcate and double in both valves; lateral teeth long, thick and nearly straight; nacre salmon colored and very iridescent.

Proc. Acad. Nat. Sci., 1873, p. 422.

Hab.—Stewart's Pond, Union Co., North Carolina, C. M. Wheatley.

My cabinet and cabinet of Mr. Wheatley.

Diam. 1·3,

Length 2,

Breadth 3·4 inches.

Shell smooth, suboblong, inflated, inequilateral, subbiangular behind and rounded before; substance of the shell thick, rather thicker before; beaks slightly prominent; ligament large, thick and dark brown; epidermis bright, polished, without rays and with rather distant marks of growth; umbonial slope somewhat raised and obtusely angular; posterior slope carinate, with a broad slightly impressed groove from the beaks to the posterior margin; cardinal teeth rather large, sulcate and double in both valves; lateral teeth long, thick, slightly corrugate and nearly

straight; anterior cicatrices distinct, large and deeply impressed; posterior cicatrices confluent, large and well impressed; dorsal cicatrices placed above the cavity of the beaks; cavity of the shell wide and somewhat deep; cavity of the beaks shallow and rounded; nacre salmon colored and very iridescent.

Remarks.—Among the numerous *Unionidæ* received by Mr. Wheatley from North Carolina were five of this species, which I believe has not been before described. It is nearest in outline to *U. Savannahensis* (nobis), but differs in being not so oblong, in having a remarkably polished epidermis, giving it the appearance of having been varnished. All these fine specimens have a more or less tint of salmon color. Other specimens may be found to be purple or white. None of the beaks were perfect enough to exhibit undulations at the tips.

SCHIZOSTOMA LEWISII. Pl. 21, fig. 16.

Testa crebrissime striata, subcylindræa, subtenui, luteo-fusca, imperforata; spira conica, plicata; suturis valde impressis; anfractibus instar septenis, ultimo grandi; fissura obliqua brevique; apertura grandi, rhomboidea, intus vittata; labro crenulato, sinuoso; columella alba, incrassata et contorta.

Shell closely striate, subcylindrical, rather thin, yellowish-brown, imperforate; spire conical, folded; sutures very much impressed; whorls about seven, the last one large; fissure oblique and short; aperture large, rhomboidal, banded within outer tip crenulate and sinuous; columella white, thickened and twisted.

Proc. Acad. Nat. Sci., 1869, p. 125.

Hab.—Coosa River, Alabama, Dr. E. R. Schowalter.

My cabinet and cabinets of Dr. Schowalter, C. M. Wheatley, Dr. Hartman and Dr. Lewis.

Diam. .5,

Length .9 inch.

Remarks.—A fine suite of different ages was sent to me by Dr. Schowalter. There can be no doubt as to its being an undescribed species. At first view it would be mistaken for *Goniobasis impressa* (nobis), but the well-indented cut at once distinguished it. It differs also, slightly, in having the striæ rather coarser and the length being less. The colored bands are very nearly the same. In the young the ground is yellow with five well-defined brown bands inside, and the folds are rather close and not much raised. I have great pleasure in naming it after James Lewis, M.D., who has done so much to make our fresh-water Molluscs known. Aperture about half the length of the shell.

GONIOBASIS LAWRENCEI. Pl. 21, fig. 17.

Testa lævi, subcylindræa, subcrassa, tenebroso-cornea, dilute vittata vel evittata; spira elevata; suturis impressis; anfractibus planulatis; apertura parviuscula, rhomboidea, intus albida; labro acuto, sigmoideo; columella incrassata et contorta.

Shell smooth, subcylindrical, rather thick, dark horn color, faintly banded or without bands; spire raised; sutures impressed; whorls flattened; aperture rather small, rhombic, white within; outer lip acute, sigmoid; columella thickened and twisted.

Proc. Acad. Nat. Sci., 1869, p. 125.

Hab.—Washita River, near Hot Springs, Arkansas, Dr. Lawrence.

My cabinet and cabinet of Smithsonian Institution.

Diam. .3,

Length 1 inch.

Remarks.—Ten specimens were sent by the Smithsonian Institution, not one of which was nearly perfect, but some were sufficiently so to satisfy me of its being undescribed. One only had bands, three in number and indistinct. The epidermis in all is uniformly of a solid polished appearance. The basal channel is wide and turned back, and resembles *G. Chrystii* (nobis) in this character. The specimens were all too much eroded to enable me to ascertain the number of whorls. The upper whorls may in perfect specimens be found to be folded or carinate. Aperture about one-fourth the length of the shell.

GONIOBASIS BACULOIDES. Pl. 21, fig. 18.

Testa lævi, cylindræa, subtenui, luteola, quadrivittata; spira valde elevata; suturis irregulariter impressis; anfractibus planulatis; apertura parva, rhomboidea, intus vittata et cæruleo-alba; labro acuto, vix sinuoso; columella vix incrassata, contorta.

Shell smooth, cylindrical, rather thin, yellowish, four banded; spire much elevated; sutures irregularly impressed; whorls flattened; aperture small, rhombic, banded and bluish-white within; outer lip acute, scarcely sinuous; columella slightly thickened, twisted.

Proc. Acad. Nat. Sci., 1869, p. 125.

Hab.—Coosa River, Alabama, Dr. E. R. Schowalter.

My cabinet and cabinets of Dr. Schowalter and Mr. Wheatley.

Diam. .4,

Length 1.2 inch.

Remarks.—Two specimens only of this fine species were sent to me by Dr. Schowalter. It must be rare in the Coosa, as he has only recently found it after so many years' explorations. It has some resemblance to *fascians* (nobis), but

differs in being larger, being cylindrical and having four bands, while *fascinans* has but three. Neither of the two specimens before me is perfect in the upper whorls, so that the character of the upper ones cannot be ascertained, nor can their number. I presume there must be nearly ten. In the larger and more perfect specimen there is a disposition to put on obtuse and indistinct folds. Aperture more than one-fourth the length of the shell.

PHYSA CARLTONII. Pl. 21, fig. 19.

Testa lævi, obtuse fusiformi, inflata, valde polita, tenui, subpurpurea; spira excerta, acuminata; suturis impressis; anfractibus senis, ultimo pergrandi; apertura ovata, grandi; labro expanso, intus marginato; columella impressa et contorta.

Shell smooth, obtusely fusiform, inflated, very bright, thin, purplish; spire raised, acuminate; sutures impressed; whorls six, the last very large; aperture ovate, large; outer lip expanded, margined within; columella impressed and twisted.

Proc. Acad. Nat. Sci., 1869, p. 125.

Hab.—Mount Diablo, California, W. G. W. Harford.

My cabinet and cabinets of Mr. Harford and Academy of Natural Sciences.

Diam. .5,

Length .9 inch.

Remarks.—This is a remarkably fine large species, which I owe to Mr. Harford. It differs from any I have seen from California in the color and size. The largest specimen, which is slightly broken at the apex, is an inch long and more than half an inch wide. A specimen two-thirds grown is entirely perfect and presents a very graceful form. These specimens have generally two longitudinal bands of growth. These bands are strongly marked with two colors, dark brown and light salmon. The color of the shell is peculiar, approaching to a purplish mahogany color. There is no species from the Pacific States which this can be confounded with except *Lordi*, Baird, which is figured in the Smithsonian Miss. Col., Part II. p. 76, by Mr. Binney. I have specimens of *Lordi* which differ in being less inflated as well as in color. These shells were found in a creek in the vicinity of Mount Diablo by Mr. H. P. Carlton, and were given to Mr. Harford, who kindly sent them to me. I name the species after Mr. Carlton.

PHYSA WOLFIANA. Pl. 21, fig. 20.

Testa subrotunda, valde inflata, polita, tenui, tenebroso-cornea; spira valde obtusa; suturis impressis; anfractibus quaternis, ultimo pergrandi; apertura ovata, grandi; labro expanso; columella medio parum impressa et parum contorta.

Shell subrotund, very much inflated, bright, thin, dark horn color; spire very obtuse; sutures impressed; whorls four, the last one very large; aperture ovate

and large; outer tip expanded; columella slightly impressed in the middle and slightly twisted.

Proc. Acad. Nat. Sci., 1869, p. 125.

Hab.—Hot Springs, Colorado Territory, Prof. J. W. Powell.

My cabinet and cabinets of Mr. J. Wolf and Academy of Natural Sciences.

Diam. .2,

Length .3 inch.

Remarks.—A number of specimens were sent to me by Mr. John Wolf, of Canton, Illinois, and I name the species after him. Mr. Wolf writes to me that they were collected by Prof. J. W. Powell, of Bloomington, Illinois, and that they were obtained from the Hot Sulphur Springs in Colorado Territory, 6500 feet above the level of the sea. The temperature of the spring where the specimens were taken out was 110°. This species is nearest, perhaps, to *Cooperii*, Tryon, from Oregon, but it is larger, more inflated and of a darker color. The aperture is three-fourths the length of the shell.

UNIO DOOLEYENSIS. Pl. 22, fig. 60.

Testa lævi, oblonga, valde compressa, valde inæquilaterali, postice biangulari, antice rotundata; valvulis subtenuibus; natibus prominulis; epidermide luteo-oliva, obsolete radiata; dentibus cardinalibus parvis, in utroque valvulo duplicibus; lateralibus longis, lamellatis rectisque; margarita livida et iridescente.

Shell smooth, oblong, very much compressed, very inequilateral, biangular behind, rounded before; valves rather thin; beaks somewhat prominent; epidermis yellowish-olive, obscurely radiated; cardinal teeth small and double in both valves; lateral teeth long, lamellar and straight; nacre livid color and iridescent.

Proc. Acad. Nat. Sci., 1873, p. 424.

Hab.—Dooley Co., Georgia, Rev. G. White; Abbeville, South Carolina, Dr. J. P. Barratt.

My cabinet and cabinets of C. M. Wheatley and Dr. Lewis.

Diam. .6,

Length 1.2,

Breadth 2.4 inches.

Shell smooth, oblong, very much compressed, very inequilateral, biangular behind and rounded before; substance of the shell rather thin; beaks somewhat prominent; ligament long, thin and dark brown; epidermis yellowish-olive, obscurely radiated, with rather distant marks of growth; umbonial slope oblique and obtusely angular; posterior slope narrow elliptical, rising to a wing, with a slightly impressed groove; cardinal teeth small, double in both valves and sulcate; lateral teeth long, lamellar and straight; anterior cicatrices distinct, rather large and well impressed; posterior cicatrices confluent, large, very slightly impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell

shallow and wide; cavity of the beaks shallow and rounded; nacre livid color and very iridescent.

Remarks.—Quite a number of specimens have been in my possession for some time. Recently I have compared them with their allied species and am now satisfied the species is distinct from any described. It is very near in outline to *errans* (nobis), but it is not so stout. It is also allied to *Hallenbeckii* (nobis), but that species is much more ponderous and is of a darker epidermis.

UNIO GESNERII. Pl. 22, fig. 61.

Testa lævi, suboblonga, inflata, inæquilaterali, postice subbiangulari, antice oblique rotundata; valvulis suberassis, antice crassioribus; natibus prominulis; epidermide tenebroso-fusca, vel radiata vel eradiata; dentibus cardinalibus crassiusculis, in utroque valvulo subduplicibus sulcatisque; lateralibus longis, crassis lamellatisque; margarita livida et iridescente.

Shell smooth, suboblong, inflated, inequilateral, subbiangular behind, obliquely rounded before; valves rather thick, thicker before; beaks somewhat prominent; epidermis dark brown, radiated or not radiated; cardinal teeth somewhat thick and somewhat double in both valves; lateral teeth long, thick and lamellar; nacre livid color and iridescent.

Proc. Acad. Nat. Sci., 1873, p. 424.

Hab.—Uchee River, near Columbus, Georgia, Dr. W. Gesner and Bishop Elliott. My cabinet and cabinet of Dr. Lewis.

Diam. .9, Length 1.6, Breadth 3.1 inches.

Shell smooth, oblong, somewhat compressed, very inequilateral, subbiangular behind and rounded before; valves rather thick, somewhat thicker before; beaks somewhat prominent; ligament moderately thick and dark brown; epidermis dark brown, obscurely rayed, with rather distant marks of growth; umbonial slope rounded; posterior slope narrow elliptical; cardinal teeth rather small and sulcate, and somewhat double in both valves; lateral teeth long, thick and lamellar; anterior cicatrices distinct, rather large and well impressed; posterior cicatrices confluent, well impressed and large; dorsal cicatrices above the centre of the cavity of the beaks; cavity of the shell wide and rather shallow; cavity of the beaks very shallow and rounded; nacre livid color and iridescent.

Remarks.—Eight specimens of various ages were sent to me by Dr. Lewis, who received them from Dr. Gesner, and I am glad to name the species in honor of him. One specimen came from Bishop Elliott. In outline it is near to *Chathamensis* (nobis) and reminds one of *errans* (nobis), but it may easily be distinguished from them. The younger specimens all have close, fine rays over the whole disk. The undula-

tions of the tips of the beaks of the young and perfect specimens are very much like those of *complanatus*, Sol.

UNIO INVENUSTUS. Pl. 22, fig. 62.

Testa lævi; oblonga, subcompressa, valde inæquilaterali, postice subbiangulari, antice rotundata; valvulis crassiusculis, antice aliquanto crassioribus; natibus prominulis; epidermide tenebroso-fusca, obsolete radiata; dentibus cardinalibus parviusculis sulcatisque; lateralibus sublongis, curvatis lamellatisque; margarita livida et iridescente.

Shell smooth, oblong, somewhat compressed, very inequilateral, subbiangular behind and rounded before; valves rather thick, somewhat thicker before; beaks somewhat prominent; epidermis dark brown, obscurely rayed; cardinal teeth rather small and sulcate; lateral teeth rather long, curved and lamellar; nacre livid color and iridescent.

Proc. Acad. Nat. Sci., 1873, p. 424.

Hab.—Columbus, Georgia, G. Hallenbeck; Russell Co., Georgia, Dr. Neisler; Irwin's Creek, North Carolina, C. M. Wheatley.

My cabinet and cabinets of C. M. Wheatley and Dr. Lewis.

Diam. .7, Length 1.1, Breadth 2.2 inches.

Shell smooth, oblong, somewhat compressed, flattened at the sides, very inequilateral, subbiangular behind and rounded before; valves rather thick, somewhat thicker before; beaks somewhat prominent; ligament small, thin and dark brown; epidermis dark brown and obscurely rayed, with rather close marks of growth; umbonial slope obtusely angular; posterior slope compressed, narrow elliptical, with a broad slight impression from the beaks to margin; cardinal teeth rather small and sulcate; lateral teeth rather long, curved and lamellar; anterior cicatrices distinct, rather small and well impressed; posterior cicatrices confluent, rather large and moderately impressed; dorsal cicatrices placed nearly in the centre of the cavity of the beaks; cavity of the shell rather shallow; cavity of the beaks very shallow; nacre livid color and iridescent.

Remarks.—Nearly a dozen specimens have been in my possession for some time, without my being able to place them in any species with which I am acquainted. It is near *basalis* herein described, but the beaks are not so medial, and it is smaller and more compressed. It is also higher in the wing and more obliquely rayed. Neither of those before me is perfect enough in the beaks to display undulations of the tips.

SOFT PARTS OF UNIONIDÆ.

UNIO TAPPANIANUS, Lea.

Soft Parts.—*Branchial uterus* occupies more than two-thirds of the anterior portion of the outer branchiæ, the sacks being filled with mature embryos as well as ova which had merely segmented. *Branchia* large, semicircular, inner ones the larger, free the whole length of the abdominal sack. *Palpi* small, obliquely triangular, united only at the upper posterior edges. *Mantle* thin, with a rather thick, broad border. *Branchial opening* rather small, with small papillæ on the inner edges. *Anal opening* small, without papillæ on the edges, but slightly crenulate. *Super-anal opening* rather long and united below. Color of the mass light salmon?

Remarks.—I owe to the kindness of Prof. S. S. Haldeman the specimen from which the above description was made. He had had it for a long time in alcohol, and it was not in a very good state for description. It was, however, a well developed female and the embryonic form was easily made out.

UNIO ROWELLII, Lea.

Soft Parts.—Several specimens were sent to me in alcohol by Mr. J. McNiel, having taken them in Estero Real, Nicaragua, West Coast. None had ova in the ovarium or branchial uterus. *Branchiæ* large, inner ones the larger, curved below, free the whole length of abdominal sack. *Palpi* small, oblique, united towards the top. *Mantle* very thin, thickened at the margin. *Branchial opening* large with numerous dark brown papillæ. *Anal opening* large, dark colored, with very minute numerous papillæ. *Super-anal opening* not large, united below. Color of the mass white.

For *hard parts* see Observations on Unio, vol. vii. p. 74, and Journ. Acad. Nat. Sci., 1859.

ANODONTA LEONENSIS, Lea.

Soft Parts.—Seven specimens were sent to me by Dr. John H. Janeway, Post Surgeon at Fort Hays, Kansas, having taken them in the Smoky Hill River branch of the Kansas. Three had charged branchial uterus. No ova in the ovaries. *Branchiæ* large, gently curved below, free the whole length of abdominal sack. *Palpi* large, ovate, united half way on posterior edge. *Mantle* thin, thick on the

border. *Branchial opening* large, black, with large papillæ. *Anal opening* not large, black and without papillæ. *Super-anal opening* long, black, and free above. Color of the mass whitish. The form of the embryonic shell is very like that of *Ferussaciana* (nobis), but is a little broader.

For *hard parts* see Observations on Unio, vol. xi. p. 29, and Journ. Acad. Nat. Sci., 1864.

UNIO HYDEIANUS, Lea.

Soft Parts.—Four males and one female were received from Dr. G. W. Lawrence from Ouachita, Arkansas. No ova were found in the ovaries or branchial uterus. *Branchiæ* rather large, inner one much the larger; slightly curved below; united the whole length of abdominal sack. *Palpi* rather small, subtriangular, united near the top. *Mantle* very thin, thicker at the margin. *Branchial opening* large, with rather large papillæ on the inner edges, which are black. *Anal opening* rather small, with numerous rather small papillæ. *Super-anal opening* rather large and united below. Color of the mass whitish.

EMBRYONIC FORMS OF UNIONIDÆ.

UNIO NASHVILLEËNSIS, Lea. Pl. 21, fig. 1. Pouch-shape; dorsal line short and straight; side margins flattened above and curved below; basal margin gently curved; color light brown. Has no hooks. Columbus, Mississippi.

UNIO NASUTUS, Say. Pl. 21, fig. 2. Pouch-shape; dorsal line rather short and straight; side margins regularly curved; basal margin round; color white. Has no hooks. Buffalo, New York.

UNIO PARVUS, Bar. Pl. 21, fig. 3. Pouch-shape; dorsal line short and very slightly curved; side margins regularly curved; basal margin nearly round; color very light brown. Has no hooks. Columbus, Mississippi.

UNIO CONCESTATOR, Lea. Pl. 21, fig. 4. Narrow pouch-shape; dorsal line nearly straight and rather short; side margins gently curved; basal margin nearly round; color clear white. Has no hooks. Columbus, Georgia.

UNIO RUBELLINUS, Lea. Pl. 21, fig. 5. Pouch-shape; dorsal line rather long and slightly curved; side margins much curved, above flattened; basal margin round; color clear white. Has no hooks. Othcalooga Creek, Georgia.

UNIO EXCAVATUS, Lea. Pl. 21, fig. 6. Pouch-shape; dorsal line very slightly curved; side margins much curved, above inflected; basal margin round; color clear white. Has no hooks. Othcalooga Creek, Georgia.

UNIO SUDUS, Lea. Pl. 21, fig. 7. Pouch-shape; dorsal line rather short and nearly straight; side margins gently curved, flattened above; basal margin nearly round; color clear white. Has no hooks. Columbus, Georgia.

UNIO FALLAX, Lea. Pl. 21, fig. 8. Pouch-shape; dorsal line rather short and straight; side margins very slightly curved; basal margin nearly round; color clear white. Has no hooks. Columbus, Georgia.

UNIO CLAIBORNENSIS, Lea. Pl. 21, fig. 9. Narrow pouch-shape; dorsal line rather short and straight; side margins straight; basal margin well curved; color nearly clear white; granules very small. Has no hooks. Columbus, Mississippi.

UNIO GIBBOSUS, Bar. Pl. 21, fig. 10. Widely pouch-shape; dorsal line long and straight; side margins slightly curved; basal margin round; color clear white. Has no hooks. Columbus, Mississippi.

UNIO OTHCALOOGENSIS, Lea. Pl. 21, fig. 11. Subrotund; dorsal line long, slightly curved upwards; side margins well bowed; basal margin round; color clear white. Has no hooks. Othcalooga Creek, Georgia.

UNIO TORTIVUS, Lea. Pl. 21, fig. 12. Subrotund; dorsal line rather long and straight; side margins regularly rounded; basal margin round; color clear white. Has no hooks. Columbus, Georgia.

UNIO PURPURATUS, Lam. Pl. 21, fig. 13. Wedge-shape; dorsal line short and straight; side margins at the middle curved outwards, towards the base curved inwards, at the base much curved outwards; basal margin well curved, wider than dorsal, forming acute angles with a minute hooklike process on each angle; clear white. Hooklike processes very small—four—one on each angle of the basal margin. Both valves inflated, being opened at both sides; color light brown; granulations indistinct. *a*, an oblique view showing the interior and two hooks at the base: *b* is a side view showing two of the four hooks: *c* is the broad side view: *d* shows the end of a valve with the two hooks. Columbus, Mississippi.

UNIO TAPPANIANUS, Lea. Pl. 21, fig. 14. Subtriangular; dorsal line long, slightly curved upward in the middle; side margins much inflated above and nearly straight below, forming an obtuse angle below; basal margin with a serrated obtuse angle. Has well developed hooks; color light brown. Columbia, Pennsylvania.

MARGARITA SPILLMANII, Lea. Pl. 21, fig. 15. Subtriangular; dorsal line very long and nearly straight, slightly raised in the middle; side margins much inflated above and slightly curved below; basal margin rounded, furnished with imperfect hooks; color light brown. Columbus, Mississippi.

On the Homologies and Origin of the Types of Molar Teeth of Mammalia Educabilia.

By EDWARD D. COPE, A.M.

I. THE TYPES OF MAMMALIAN MOLARS.

It has been already stated* that the transition from simple to complex teeth is accomplished by repetition of the type of the former in different directions. "In the cetaceans this occurs in the Squalodonts; the cylindric incisors are followed by flattened ones, then by others grooved in the fang, and then by two-rooted, but never by double-crowned teeth. This is the result of antero-posterior repetitive acceleration of the simple cylindric dental type of the ordinary toothed cetacean. Another mode of dental complication is by lateral repetition. Thus the heel of the sectorial tooth of a carnivore is supported by a fang alongside of the usual posterior support of a premolar, and is the result of a repetitive effort of growth-force in a transverse direction. More complex teeth, as the tubercular molars, merely exhibit an additional lateral repetition, and sometimes additional longitudinal ones. As is well known, the four tubercles of the human molar commence as similar separated knobs on the [primitive] dental papilla."

Accordingly the simple tubercle may be regarded as the least specialized form of tooth. It may be low and obtuse, as in the *Chiromys*, or walrus; more elevated and conic, as in the dolphins; or truncate, as in sloths and some rodents. The form is complicated in two ways, viz., either by the folding of the sides, as in *Glyptodon* and many rodents, as *Arvicola*, *Castor*, *Lepus*, etc.; or by the development of tubercles on the crown, as in *Mus*, *Dicotyles*, *Homo*, etc. Upon this basis are constructed the more complex types of teeth exhibited by the various families of *Ungulata* and some *Rodentia*, as has been pointed out in the following language: "The genus *Eobasileus* has been shown to be a Proboscidian which combines some important features of the *Perissodactyla* with those of its own order. . . . The number of such characters was shown to be somewhat increased in *Bathmodon*, which therefore stands still nearer to the common point of departure of the two orders. This point is to be found in types still nearer the clawed orders (*Ungui-*

* Method of Creation, p. 10, Philadelphia, 1871.

culata) in the number of their digits (4, 5), and in which the transverse and longitudinal crests of the molar teeth are broken up into tubercles more or less connected, either type of dentition [*i. e.* Proboscidian or Perissodactyle] being derived according as such tubercles are expanded in the transverse or longitudinal directions.”*

The proper homologizing of the various forms of dental structure of the Ungulates with each other, and with the primitive types of tubercular teeth, is entirely essential to their intelligent classification, and therefore comprehension of their mode of origin. In order to lay a foundation for this work, I define the four types as follows, giving the subdivisions of the first two in brief, and discussing those of the third and fourth more fully afterwards.

Fig. 1. Division I. *Haplodont* type; the crown undivided or simple.



Globicephalus.

- a. Crown low, obtuse; *Cetacea* (*Beluga*), *Carnivora* (*Rosmarus*).
- b. Crown elevated, acute; *Cetacea* (*Delphinus*); canine teeth in general.
- c. Crown truncate; *Edentata* (*Bradypus*); *Rodentia* (*Geomys* *Dipodomys*).

Division II. *Ptychodont* type; the crown folded on the sides; the folds frequently crossing the crown.

Fig. 2.



Jaculus hudsonicus.

- a. Sides only folded; *Rodentia* (*Arvicola* *Castor*); *Edentata* (*Glyptodon*).
- b. Summit of crown also folded; *Rodentia* (*Lepus*, *Chinchilla*).

Division III. *Bunodont* type; crown supporting tubercles.

Fig. 3.

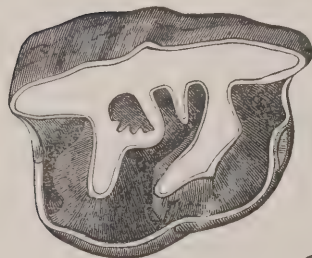


Leptachoerus.

- a. Tubercles few opposite; *Ungulata*, *Achænodon*,† *Dicotyles*, *Elotherium*; *Carnivora*, *Procyon*; *Rodentia*, *Heliscomys*.
- b. Tubercles few alternate; *Hyopsodus*.
- c. Tubercles numerous, irregular; *Mastodon*, *Phacochærus*.

Division IV. *Lophodont* type; the summit of the crowns thrown into folds of transverse or longitudinal direction.

Fig. 4.



Rhinoceros.

This division embraces the many types observed in the Ungulates, some Rodents, and possibly Carnivora. Inasmuch as the teeth of the maxillary and dentary (mandibular) bones do not always conform to the same type (e. g. *Symborodon*, *Equus*), it will be necessary to consider them separately. Besides the difference in type, they differ in their relative development in width in the more special-

* On the primitive types of Mammalia Educabilia, published by E. D. Cope, May 6th, 1873.

† See Cope, Palæontological Bulletin, No. 17, p. 2.

ized forms; thus in *Homo*, *Mus*, *Mastodon*, and such genera, the molars of both jaws are identical; in *Palæotherium*, *Eobasileus*, *Tapirus*, etc., and most *Carnivora*, the superior are the wider, the inferior narrower appropriately to the greater slenderness of the mandibular bone. The latter, or anisognathous type, may then be regarded as the more specialized. The Bunodonts, except some *Carnivora*, are all of the former or isognathous type; among Lophodonts the few Rodents, the *Dinothereiidae*, and *Elephas* are isognathous, while all of the other *Proboscidea*, the *Perissodactyla*, and *Ruminantia* are anisognathous. Examples may be selected as follows:—

Isognathous; Bunodonts, *Homo*, *Dicotyles*, *Sus*, *Mastodon*, *Elotherium*; Lophodonts. *Dinothereiidae*, *Elephas*; *Rodentia*, *Sciuridae*.

Anisognathous; Bunodonts; *Macacus*, *Lemuroidea*, *Procyon*; Lophodonts; *Anoplotherium*, *Hyopotamus*, *Oreodon*, *Ruminantia*, *Perissodactyla*, *Bathmodon*, *Eobasileus*.

II. THE SUBORDINATE TYPES OF LOPHODONTS.

1. *The Maxillary Teeth.*

In the essay already quoted* the following remarks (p. 7) explain the relation between the Bunodont genera and several of the Lophodont types of superior molar teeth. "In the superior molar series the flattening of the outer tubercles may proceed so far as to produce, on wearing, a confluence of the [resulting] crescentoid surfaces. . . . In both *Palæosyops* and *Hyrachyus* these tubercles of the upper molars are confluent into two Vs (more or less open when unworn). In the former the inner tubercles retain their primitive conic tubercular form, but in *Palæotherium*, *Rhinocerus*, *Lophiodon*, *Hyrachyus*, and *Tapirus* they elongate transversely so as to meet the corresponding outer tubercles (now crests) forming the familiar cross-crests of those genera. If alternate, the oblique crests of *Palæotherium*; if opposite, the cross-crests of *Tapirus*. If, on the other hand, the inner tubercles flatten like the outer, we have, on wearing, the quadricrescentoid [Selenodont] type of the *Ruminantia* and *Anoplotherium*. But it is important to observe that the lower types of *Quadrumania* and *Carnivora* present the quadrituberculate crown with tendency to flattening of the outer tubercles and the entire loss of the inner, the 'heel' being in the dogs and cats, *e. g.*, their only representative. In the *Quadrumanous* families, including man, the primitive quadrituberculate type of molars is preserved."

Four types of Lophodont dentition are included in the above discussion, and three others may be added. They belong to two series, viz., those in which the

* Primitive Types of Mammalia Educabilia, May, 1873, and Hayden's Report on Geological Survey of Montana, Wyoming, etc., 1873, p. 646.

crests represent the modification of opposite tubercles, and those where the tubercular elements of the crown are alternate. These series may be called the *Amæbodont* (alternate), and *Antiodont* (opposite), and the component types are—

ANTIODONTS.

Selenodont (Ruminants); *Tapirodont* (*Tapir*, *Rhinocerus*); *Trichechodont* (manati, Elephant).

AMÆBODONTS.

Palæotheriodont (Palæotherium, etc.); *Symborodont* (Palæosyops Symborodon, etc.); *Bathmodont* (Bathmodon, etc.), *Loxolophodont* (Uintatherium, etc.).

These types are defined as follows:—

1. ANTIODONTS.

Selenodonts.

The tubercles separate or united at their angles, much elevated, narrow crescentic in section, separated by deep valleys.

To this group belong the molars of the Ruminants, the *Tragulidæ*, the *Oreodontidæ*, and *Merycopotamidæ*; of Perissodactyles the *Equidæ*.

Tapirodents.

The outer tubercles longitudinally compressed, subcrescentic in section; the inner transversely compressed, continued as transverse ridges to the end or middle of the corresponding exterior crests.

Rhinoceros, *Tapirus*, *Hyrachyus*, *Lophiodon*, and *Hyrax* represent this type; the last molar of *Lophiodon* appears to be *Amæbodont*.

Trichechodonts.

Tubercles confluent into two or more transverse crests.

The *Dinotherium* represents this form, so does *Elephas*, *Trichecus* (the manati), and a number of the larger *Marsupialia*.

2. AMÆBODONTS.

Palæotheriodonts.

External tubercles longitudinal, subcrescentic in section; the inner united with them by transverse oblique crests.

Palæotherium and *Anchitherium* present this type, which only differs from the *Tapirodont* in the alternation of the opposing tubercles.

Symborodonts.

External tubercles longitudinally compressed and subcrescentic in section; the inner independent and unaltered, *i. e.* conic.

To this group are to be referred the types of *Palæosyops*, *Titanotherium*, and *Symborodon*. They, of all *Lophodonts*, approach nearest to the *Bunodonts*.

Bathmodonts.

The posterior pair of tubercles approximated and connected, together compressed and subcrescentoid in section; the anterior outer connected with the anterior inner by an oblique crest forming a V with the preceding.

Bathmodon and *Metalophodon*. The homologies of the crests are difficult to make out; the subcrescentic crest may include only the posterior outer tubercle and thus be entirely homologous with the posterior crescent of *Palæosyops*. In support of this view we have the structure of the premolars where it becomes the only external crescent, while the anterior transverse crest turns round on its inner side, supporting the inner anterior tubercle of the tooth. But the fact that there are two crests on it in the true molars, that one of these is near the position of the inner anterior tubercle, and the fact that there is no other posterior tubercle, render it probable that the homologies expressed in the above diagnosis are correct.

Loxolophodonts.

Anterior inner tubercle connected with the two external by oblique crests; the posterior inner tubercle rudimental or wanting.

Uintatherium and probably *Tillotherium* represent this group, both being like those of the last, extinct genera from the Eocene of Wyoming.

2. *The Mandibular Teeth.*

The types of structure are less numerous than those of the maxillary teeth, since I am only acquainted with six. Still more distinctly than those of the upper jaw, do they represent the types of opposite or alternating tubercles, or the antiodont and amœbodont. The essential principles of modification are the same as in the maxillaries, and they correspond with them as to genera, as follows:—

Antiodont.

Inferior.	Superior.
Selenodont.	Selenodont.
Hyracodont.	Tapirodont pt.
Trichecodont.	{ Tapirodont pt.
	{ Trichecodont.

Amæbodont.

Symborodont.	{ <i>Palæotheriodont.</i>
	{ <i>Symborodont.</i>
Hippodont.	Selenodont pt.
Loxolophodont.	{ Bathmodont.
	{ Loxolophodont.

The characteristics of these groups are as follows:—

A. ANTIODONTS.

Selenodonts.

Constructed, typically, like the upper molars. *Ruminantia.*

Hyracodonts.

External tubercles compressed longitudinally and crescentic in section, continuous by a cross crest with the corresponding tubercle of the inner side.

The animals which possess this type of teeth are the *Rhinocerus*, *Hyracodon*, and the *Hyrax*; it is nearly approached by some of the *Hyrachyi*. It corresponds in structure with the true tapirodont arrangement of the maxillary teeth; but many of the Tapirodonts have the Trichecodont type of mandibular teeth.

Trichecodonts.

Definition the same as for the maxillary teeth.

Tapirus, *Lophiodon*, *Hyrachyus*, *Dinotherium*, *Elephas*, *Trichecus* (the manati), and the Kangaroos and their extinct allies belong here.

B. AMÆBODONTS.

Hippodonts.

In the horses the maxillary molars are constructed on an opposite crested basis, while the mandibulars represent an alternate crested type. This is not constituted as in the next form, by a union of alternating tubercles, but as in the *Selenodonts* by the special development of each crest into a crescent extended antero-posteriorly. As alternating, the inner crescents stand at the apices of the outer, and are connected with them. In *Anchitherium* the inner are so reduced as to constitute a condition intermediate between the *Hippodont* and *Symborodont* types.

Symborodonts.

The alternating tubercles connecting by oblique ridges which form together two Vs.

To this type is to be referred a great number of *Perissodactyles*, e. g., *Anchitherium*, *Palæotherium*, *Palæosyops*, *Titanotherium*, *Symborodon*, *Anchippodus*.

Loxolophodonts.

Alternate cusps connected by two cross ridges from the outside forwards, and one from the inside forwards; from which result an oblique posterior cross ridge, and a V opening inwards.

Here are *Eobasileus* and *Bathmodon*; the last molar of the latter having the anterior ridge of the V quite low.

3. COMPARISON OF THE OPPOSING SERIES.

In review, the above types of molar dentition may be classified as follows, with reference to the amount or complication of the modification of the tubercular type. The orders of *Ungulata* with which they correspond, are also given.

α . Both inner and outer tubercles crescentoid.

Selenodonts.	{	<i>Ruminantia</i> . <i>(Anoplotherium, Oreodon, Hyopotamus)</i> . <i>Perissodactyla (Equidæ)</i> .
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β . External tubercles only crescentoid; the inner transverse or tubercular.

Tapirodonts.	}	
Palæotheriodonts.	}	
Symborodonts.	}	<i>Perissodactyla</i> in gen.

γ . Neither kind of tubercles crescentoid, but united in pairs.

Trichecodonts.	}	
Bathmodonts.	}	
Loxolophodonts.	}	<i>Proboscidia</i> .

It may be added that the groups arranged under γ are the only ones in which the types of crests of the superior and inferior molars are fundamentally simple and alike. Thus in the group α , tubercles of both upper and lower series are modified independently to produce the type; in group β , the tubercles of the upper series are modified independently of each other, while those of the inferior series unite, in order to produce the result; in division γ the tubercles of both jaws unite entirely across the crown, without any distinction between those of the outer and inner sides. Thus the molar type of dentition of the *Proboscidiæ* is the most generalized among the Ungulates, resembling in this respect the type of construction of the feet.

III. THE ORIGIN OF THE TYPES OF LOPHODONT DENTITION.

The four types of molar dentition, the Haplodont, Ptychodont, Bunodont, and Lophodont, are by no means sharply defined, but pass into each other by insensible gradations at many points. With regard to the two types last named, the transi-

tions are very obvious, so much so as to lead to the belief that the several subdivisions of the Lophodonts represent modifications of corresponding types of Bunodonts, and that the two are partially "homologous groups." Both present corresponding Amœbodont and Antiodont types; as an example of the former kind of Bunodont, the mandibular molars of the genus *Hyopsodus* may be cited; of the latter kind, the same of the genus *Achænodon*, both the earliest, or Eocene genera. It remains to indicate the intermediate forms, if any there be, which give color to the supposition that the various divisions of Lophodonts have descended from Bunodont predecessors. Here, then, I mention a fact of prime importance; *i. e.*, that in America at least, no Selenodonts are known from formations of older age than Miocene; while the greatest development of Bunodonts is in the beds of the next older epoch, the Eocene.

The special forms of Lophodonts may be separately considered as follows:—

First, as to the opposite and alternate types, or the Antiodont and Amœbodont. They pass into each other by many intermediate conditions among the Bunodonts, as in *Notharctus*, *Limnotherium*, etc. of the Wyoming Eocene. There is reason, also, to believe that this has been the case with some of the Lophodonts after they had left the bunodont stage behind. Thus *Equus* is an antiodont as to its upper molars, but has been probably derived from *Palæotheriodont* ancestors, which are amœbodont; this is rendered especially probable by the fact that the mandibular teeth are of the amœbodont division (hippodont). It is also highly probable that the antiodont genus *Tapirus*, though so near to *Palæotherium*, was derived from an antiodont Bunodont. Hence, while the discrimination between opposite and alternate types is in some cases most radical, in others its importance is but slight.

I. ANTIDONTS: Bunodont type *Achænodon*. (Fig. 5.)

1. *Selenodont* type approximated by the bunodont *Hippopotamus*, where the tubercles

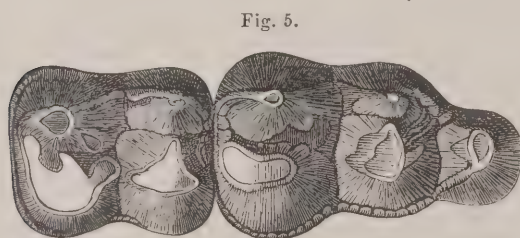


Fig. 5.

Achænodon.

are compressed, thus: the intervening valleys are deepened, and the cusps wear readily into

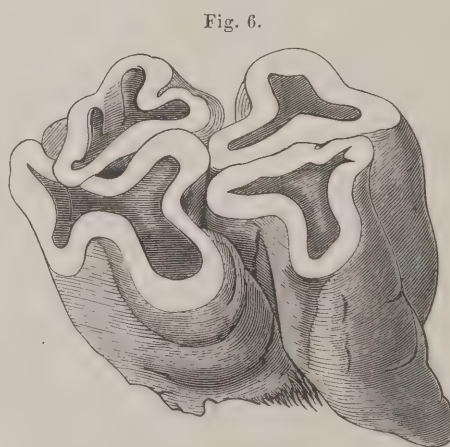
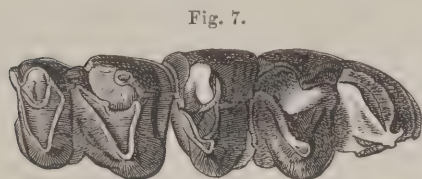


Fig. 6.

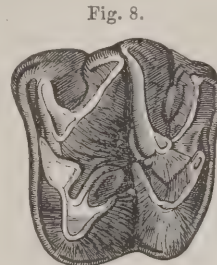
Hippopotamus.

separate crescents. Another intermediate form is seen in the genus *Anthracotherium*,



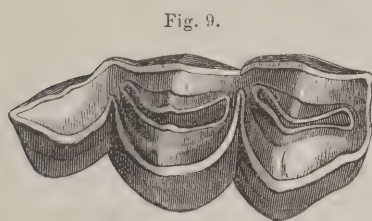
Anthracotherium velatum.

where the tubercles of the mandibular teeth are compressed, while they remain conic (Fig. 7); selenodont forms of *Omnivora* present us with near approaches



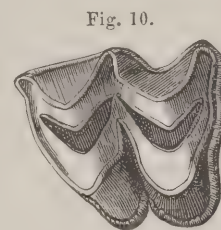
Hyopotamus americanus.

to these Bunodont genera. Thus in *Hyopotamus* and *Anoplotherium*, the crowns, when unworn, present four principal tubercles, which are openly V-shaped in section, and which are separated by open valleys. The latter are deeper than those of the truly *Bunodont* genera, but much shallower than those of the typical *Selenodonts*. In *Oreodon* the valleys are somewhat deepened and the crescents elevated, while in the deer the same infolding



Procamelus robustus.

is carried still further. In the *cavicornia* the type reaches its fullest expression in the loss of the shoulder at the base of the crown, the great elongation of the latter, and correspondingly deep infolding of the terminal valleys.



Merychys major.

Prof. Lartet* states that the most ancient deer have very short-crowned molars, and the depressions on the surface are so shallow that the bottom is always visible, while in the *Cervidæ* of the more recent tertiary periods, and especially the Pliocene and living species, these same cavities are so deep that whatever be the state of attrition, the bottom cannot be seen. This, he says, is a perfectly reliable rule for distinguishing the ancient from the more modern forms of deer, and can be applied to other animals as well as the *Cervidæ*.

The writer nearly contemporaneously† recalled the observations of Leidy that the teeth of the Oreodont "*Merychys* are more prismatic, have larger crowns and shorter roots, approaching the sheep, as *Oreodon* does the deer." Now *Oreodon* is Miocene, and *Merychys* Pliocene. It was then observed: "This phenomenon suggests an explanation on the score of adaptation which the other cases do not. The existence during the later period, of a [hard]er material of diet would increase the rapidity of wearing of the crown of the tooth, and require a longer crown and greater rapidity of protrusion. This necessitates a diminution of the basal shoulder and shortening of the roots producing the prismatic form aforesaid."

* Comptes Rendus, 1868, p. 1119.

† Proceed. Acad. Nat. Sciences of Philadelphia, 1868, p. 274: Origin of Genera, 44.

These observations render it highly probable that the selenodont molar is produced by a modification of the antiodont bunodont molar. Also, that the manner of the change has been by constant acceleration of growth of the folds of the tooth upwards and perhaps downwards in its long axis; and an acceleration in the lengthening of the crown.

Fig. 11.



Tapirus.

2. *Tapirodonts*.—This form is so nearly similar to the Palæotheriodont, that any series annectant between the latter and the Bunodonts will render very probable such a connection for the Tapirodonts also. Indeed, it is clear that the same evidence will be sufficient in both cases, since the premolars and last molar of *Lophiodon* are amœbodont, like *Palæotherium*. In point of fact, however, the tubercles of the molars of *Achænodon* are partly united in transverse pairs, while there are connecting tubercles connecting the opposite cones in some molars of *Elotherium*. These structures foreshadow this group as well as the Trichechodont.

3. *Trichecodonts*.—The *Mastodons* and Elephants form a most complete series between this form and the Bunodonts, as has been pointed out by Falconer. In this series, the transverse rows or pairs of tubercles, as well as the crests, may be few or many. Thus in *Elotherium*, *Halitherium*, and *Trichechus* they are few; in *Trachytherium* and *Dinotherium* more numerous; in *Mastodon*, *Stegodon*, *Tetracaulodon*, and *Elephas*, most numerous. The tubercles are united into serrated cross-crests in *Halitherium*, the extinct sea cow; in *Trachytherium*, another fossil ally of the Manati, the tubercles are not united. The succession from *Mastodon*

Fig. 12.



to *Elephas* may be represented by the accompanying figures. Fig. 12 (from Cuvier) is a molar of *M. angustidens*, where, besides the principal tubercles, numerous lesser

Fig. 13.

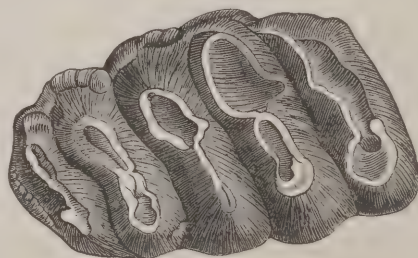
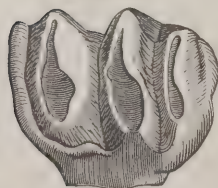
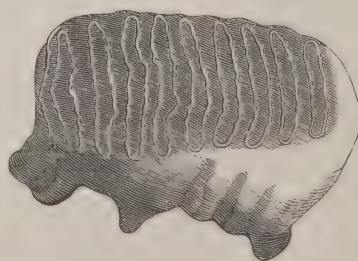


Fig. 14.



ones appear. Fig. 13 represents *Tetracaulodon ohioiticus*, in which the opposite tubercles are nearly united into transverse crests. In *Dinotherium* (Fig. 14) and *Elephas* (Fig. 15) the union is complete.

Fig. 15.



The relations of these genera have been described

as one of "inexact parallelism;" a condition supposed by the writer to depend on modification in descent under the law of acceleration. The language used is:*

"The young tooth of *Elephas*, moreover, is represented by a series of independent parallel laminæ at first, which when they unite, form a series of crests similar to the type [*i. e.* pattern] of the genus *Mastodon* [*Stegodon*] and others of the beginning of the series. The deposit of cementum takes place later, till the valleys are entirely filled up. Thus the relations of this part of the tooth structure in the series are also those of the successional growth of those of *Elephas* or the extreme of the series." The history of the origin of this type of dentition is no doubt similar to that of the Selenodonts.

The transition from the bunodont type to the present one in the mandibular dentition is seen in the Eocene genera *Microsypops* and *Limnotherium*, where the opposite cones are connected by a low cross-crest.

Fig. 16.



Microsypops elegans.

II. AMŒBODONTS; Bunodont type *Hyopsodus*.†

Fig. 17.



Hyopsodus.

4. *Symborodonts*.—In *Hyopsodus* the exterior cones are already somewhat excavated on the inner side, so that a section of each is somewhat triangular. It is obvious that but little more compression and curvature

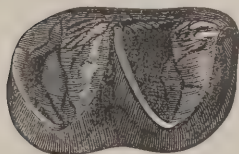
Fig. 18.



Palæosyops lævidens.

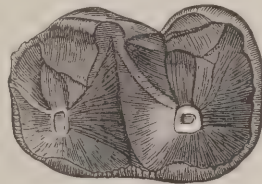
is required to produce the type of *Palæosyops*, etc. (Fig. 18). The angles of the outer cones in *Hyopsodus* are also slightly produced as low ridges to the bases of the alternating tubercles of the opposite side: the elevation of these ridges is only necessary to produce the two Vs of the mandibular dentition of *Palæotherium*, *Palæosyops* (Fig. 20), *Symborodon*, *Anchippodus* (Fig. 19), and all their allies (Fig. 21, *Palæotherium*).

Fig. 19.



Anchippodus.

Fig. 20.



Palæosyops.

Fig. 21.



Palæotherium.‡

* Origin of Genera, p. 17.

† I originally (On the Primitive Types of Mammalia Educabilia, p. 9; Hayden's Geolog. Survey Terr., 1872, 1873, p. 648) selected *Oligotomus*, Cope, for this position, but as it has a considerable diastema, it is probably better exchanged for *Hyopsodus*, where the dental series is uninterrupted.

5. *Palæotheriodont* type.—Immediately following the form of the *Palæosyops* molar we have that of *Hipposyus*,* where intermediate tubercles stand between

Fig. 22.

*Hipposyus*.

the inner subconic and the exterior longitudinal crescentoid tubercles. They are compressed so as to be transverse, and only need more complete connection with the adjacent tubercles to give the oblique transverse ridges of *Anchitherium*, *Palæotherium*, and *Hyracodon*, *Rhinocerus*, etc. *Hipposyus* was originally compared with *Anchitherium* by Dr. Leidy, and the writer in ignorance of his language remarked:† “An interesting annectant form is seen in *Orohippus procyoninus*, where the two intermediate tubercles which separate the inner cones from the outer Vs in *Limnohyus* are so developed as to constitute parts of an incomplete pair of transverse ridges which disappear in front of the bases of the outer Vs. They represent the oblique crests of *Palæotherium* and *Anchitherium*, and thus the genus *Orohippus* furnishes a station on the line from *Palæosyops* to the horses.” Contemporaneously and quite independently Prof. Marsh expressed similar views‡ as to its affinities.

A greater longitudinal extent of these ridges or longitudinal expansion of the tubercles in the molars in both jaws, the oblique connections being still retained, gives the type of *Equus* (Fig. 25). The elevation of the tubercles and deepening of the valleys gives us the Selenodont type of superior molars again in this genus; while the lower molars only differ from that type in having the crescents alternate instead of opposite, forming the Hippodont pattern (Fig. 26). There can be little

Fig. 23.

*Hipposyus*.

Fig. 24.

*Hypohippus*.

Fig. 25.

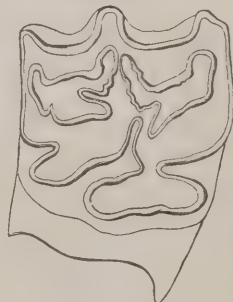
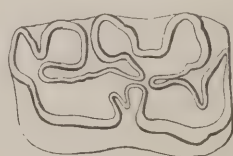


Fig. 26.

*Equus*.

doubt that the line of the horses comes through *Hipposyus* from the Bunodonts, rather than through *Palæotherium*, as has been suggested by some writers.

* This genus was named by Leidy June, 1872 (Philada. Acad., p. 37); August 3d, 1872, the writer called it *Helotherium*; and Aug. 7th, 1872, it was named *Orohippus* by Marsh, etymology from *ἵππος* and *σῦς*, hence distinct from *Hippohyus* C. and F.

† Hayden's Geol. Surv. Montana, etc., 1873, p. 647.

‡ Amer. Journ. Sci. Arts, 1873, p. 407.

6. *Bathmodont* type.—I know of no genus which by its intermediate structure connects this type of molar with the Amœbodont form of Bunodonts. Such will doubtless be discovered, for it is impossible that the upper molar of *Bathmodon* could have been produced by the modification of any known Palæotheriodont, the type which it most nearly resembles. The structure of the feet of the animal forbids any such supposition. Such intermediate types would have, firstly, the (oblique) crests more nearly equal in length and similar in direction. A depression of the crests and indication of diagonal ridges connecting the tubercles in the opposite direction would produce an approach to a W, and the form of *Hyopsodus*. That this was probably the history of this curious type is rendered probable by the form of the mandibular teeth, which exhibit two of the intermediate stages above anticipated. Thus the last inferior molar exhibits two obliquely transverse crests of subequal length, with rudimental oblique or diagonal ridges connecting them. In the median lower molars one of the latter is developed, giving a V, as in *Palæotherium*, but the posterior one is undeveloped, leaving only the original oblique cross-crest.*

Fig. 27.

*Bathmodon.*

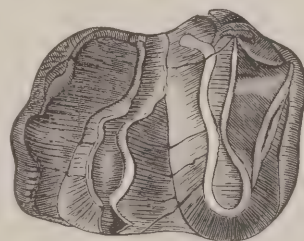
7. The *Loxolophodonts*.—Like the preceding group I know of no type connecting this form with the Bunodont, but anticipate the discovery of a type with a rudimental posterior V on the upper molars, which shall connect it with the W-shaped type proposed above as the probable predecessor of *Bathmodon*. Or, a pair of oblique parallel crests with rudimental diagonals like the posterior lower molars of *Bathmodon* may intervene between this form and the Bunodont. This is, how-

Fig. 28.



ever, not probable in view of the diagonal crest of the upper molars (Fig. 28, *Uintatherium robustum*), and especially if the parallel with the type of the lower molars is kept up. These are like those of *Bathmodon*, except that the type of the middle

Fig. 29.



* See Proceed. Amer. Philosophical Society, Sept. 1872, "On the Dentition of *Metalophodon*."

molars of the latter is continued to the posterior end of the series in *Uintatherium* (Fig. 29); that is, the last molar of the latter consists of a V and an oblique cross-crest.

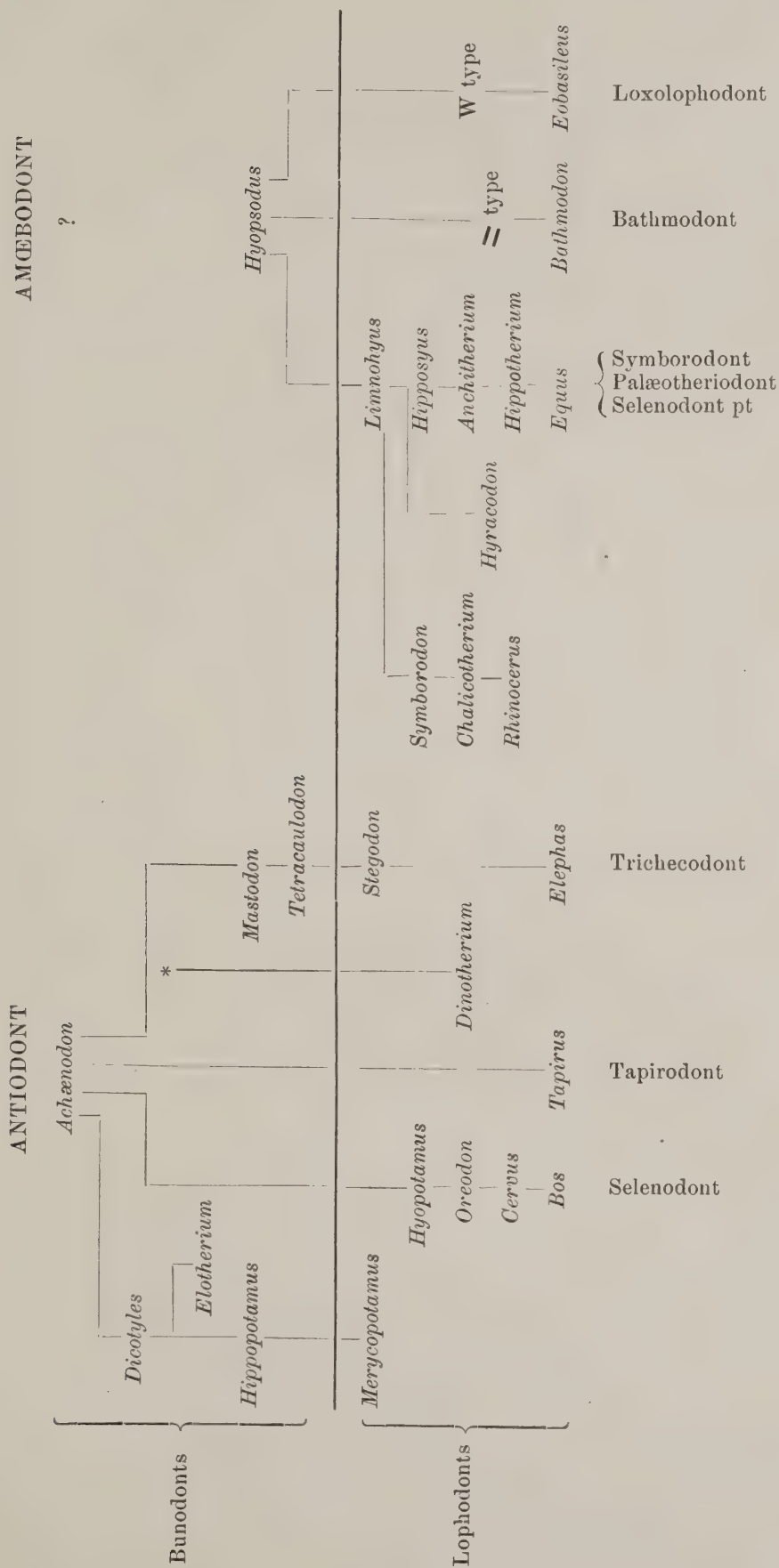
IV. RELATIONS OF THE TYPES OF DENTITION TO TYPES OF FOOT STRUCTURE.

I hope that I have succeeded in showing that the Bunodont and Lophodont types of dentition form two homologous series, similar to those already indicated among *Batrachia*, *Cephalopoda*, etc.* That this relation indicates descent of the corresponding terms of the one series from those of the other has also been rendered highly probable. This conclusion has also been previously stated as a theorem,† as follows: "V* The heterologous terms or genera in the later series are modified descendants of those of the earlier series;" in other words, that certain groups higher than genera are produced from others of a similar high value by "descent with modification."

As already pointed out, the Bunodont primary genera belong to the older geologic epoch of the Eocene, while most of the derivative ones belong to later periods. Some were contemporary with the primary forms, but doubtless have descended from pre-existent members of the same type as yet unknown to us. The genus *Achænodon*, Cope, is especially generalized in three respects: (1) the simplicity of the construction of its molars; (2) the same simplicity of the premolars, which are without inner or posterior lobes; (3) the absence of all diastemata and consequent continuity of the dental series. Hence it may be regarded as more primitive than *Palæochærus*, *Chæromorus*, *Dicotyles* or *Elotherium*, in all which there are marked diastemata. The two series may then be arranged as follows: with the understanding that in some cases names of genera used, represent rather family groups, in which the special generic lines have not yet been made out.

* See Origin of Genera, p. 53.

† Loc. cit. p. 79.



The preceding table has been already published in its essential features in the Report on Geological Survey of the Territories, 1873, p. 648.*

It remains now to ascertain whether the genealogical or taxonomic relations expressed by the teeth coincide with those derived from the other diagnostic regions of the body. First of these must be selected, as of chief importance, the limbs and feet.

We may look on the *Artiodactyla*—even-toed or cloven-footed mammals—as one of the most homogeneous groups in the class, not only in respect to the structure of the extremities, but also in that of the cranium, vertebræ, etc. But here we have both *Bunodont* and *Selenodont* types of molars. The *Perissodactyla*, as defined by the feet, axis, palate, etc., present us with the *Symborodont*, *Palæotheriodont*, *Tapirodont*, and *Selenodont* types of dentition in the superior series, and the *Hippodont*, *Hyracodont*, *Palæotheriodont*, and *Trichechodont* types in the mandibular teeth. The pentadactyle, plantigrade type, for which I have used the name *Proboscidea*, presents us with the *Trichechodont*, *Bathmodont*, and *Loxolophodont* types of molar structure. Among Sirenians, as defined by the marked peculiarities of the entire skeleton, we have the great differences in dentition presented by *Halicore* and *Trichecus*, the former being *Haplodont*, the other *Trichecodont*. Finally, the Marsupial group is unquestionably well defined, and here *Phascolomys* is *Ptychodont*; *Hypsiprymnus* *Bunodont*; *Petaurus* between *Bunodont* and *Selenodont*, and the Kangaroos and their gigantic extinct allies the *Diprotodontidæ*, *Trichecodont*.

It is thus evident that the molar types are everywhere subordinated to those which we call ordinal; therefore in the case of the placental mammals, and especially those with complex folding of the cerebral hemispheres, to the types of construction of the feet. As to the modifications presented by the canine and incisor teeth; these exist within a still more narrow range of variation; for instance, in the allied genera *Equus*, *Rhinaster*, and *Symborodon*; *Sus* and *Phacochærus*; *Bathmodon* and *Eobasileus*, and others.

It is thus probable that modifications in the three points of structure considered were introduced in the following order:—

First, Of the feet.

Second, Of molar type.†

* It was previously published in a separate form in "On the Primitive Types of Mammalia Educabilia," May 6, 1873. An error occurs in this edition in the reversal by a lapsus calami of the positions of the types *Omnivora* and *Anoplotherium*. It is also important to note, that in the "Report G. S.," p. 645, where it is stated that "during the Eocene they (the orders) were in process of differentiation," etc., *Mammalia Educabilia* and not *Lisencephala*, are referred to.

† In the case of the *Marsupialia* the relation of the dental and extremital types may be reversed. Thus we have pentadactyle plantigrade forms (Opossums) and (nearly) didactyle digitigrade forms (*Macropus*) in the same order. Also *Halmaturus* and *Diprotodon*, both Trichecodonts, differ in the type of feet, as do the carnivorous *Didelphys* and *Thylacinus*, both *Bunodonts*.

Third, Of the relations of canines and incisors.

With regard to the significance of the three types of feet, *Proboscidian*, *Perissodactyle*, and *Artiodactyle*, it has been already remarked: "It is to be observed that the lines of *Ungulata*, *Quadrumana*, and *Carnivora* originate in plantigrade types, a state of things quite predominant among the lower series or *Lissancephala* (smooth brains). It is universal in *Edentata* and very usual in *Rodentia* and *Insectivora*. The lower forms of *Marsupialia* and all of the *Monotremes* present it. In the *Marsupials*, *Rodents*, *Ungulates*, and *Carnivores* we have series whose highest expression is in the most highly digitigrade genera."* To this it may be added that the lower terrestrial vertebrates are plantigrade, with some exceptions. Thus in some Anurous *Batrachia* there is a partial digitigradism; the only digitigrade *Reptilia* are some *Dinosauria*, especially such carnivorous forms as *Laelaps*; all birds are digitigrade. The digitigrade modification evidently has reference to speed in running or projectile force in leaping.

The connecting points between the different types of foot-structure among the *Mammalia Educabilia* are as obvious as in the case of the types of molar structure. Examples may be adduced as follows:—

Artiodactyla.

Approximations to the *Perissodactyla* are to be seen in *Hippopotamus* in the increase in development of the lateral or first and fourth digits, thus equalling the number in the fore foot of *Tapirus* and *Brontotherium*, though preserving the equality of the two median digits. But an inequality of these digits appears in the genera *Anoplotherium* and *Cænotherium*, as has been stated† in the following language: "In *Anoplotherium secundarium* the digit *ii* is developed in each foot, though not nearly so long as *iii*, which is nearly symmetrical in itself. There is an approach to the same structure in the manus of *Cænotherium*." The only approximation to the Proboscidian type is to be seen in the shortening of the metapodial bones in *Hippopotamus*, a point of very inconsiderable value.

Perissodactyla.

Approximation to the preceding order is made in the anterior foot of *Brontotherium*, in which, according to Marsh, there are four toes of nearly equal size.‡ Approximation to the *Proboscidea* is seen in *Symborodon*, where the cuboid facet of the astragalus is rather larger than in *Rhinoceros*, and developed much as in

* *Mammalia Educabilia*, p. 8; Hayden's Geological Survey, 1873, p. 647.

† Huxley, *Anatomy of the Vertebrated Animals*, p. 321.

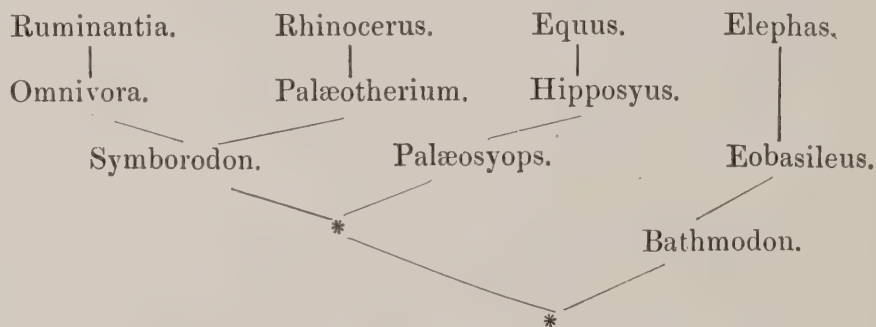
‡ *American Journal of Science and Arts*, 1873, p. 486.

Bathmodon; the small third trochanter of the femur is also much like that in *Bathmodon*. The osseous horn-cores may be compared with those on the front of *Loxolophodon*. The knee was probably free from the integument of the abdomen, as in Proboscidiæ. In all other respects there is no approximation to this order.

Proboscidiæ.

The approximations to other orders in the structure of the feet are only to be seen in the Eocene genera *Bathmodon* and *Eobasileus*. The latter, or its ally *Uintatherium*, presents, according to Marsh, but four toes on the hind foot; the anterior has five. In the former point we have a resemblance to *Hippopotamus*, but one of little significance, in view of the radical differences between the two in the form of the astragalus, calcaneum, and cuboid bones. The former is essentially Proboscidian in all respects, with the addition of a cuboid facet alongside of and behind the navicular, as in *Symborodon*; thus constituting a Perissodactyle character, but leaning to the forms of that order which betray probably the closest, though slight, approach to the omnivorous division of the *Artiodactyla*. Thus while the *Eobasiliidæ* present the Proboscidian type of feet and molar dentition, if they present any ordinal characters resembling those of the *Artiodactyla*, they are equally shared by certain extinct *Perissodactyla*.

From the hints above furnished, we may regard the succession of modifications of foot structure to be nearly as follows:—



V. THE ANCESTRAL TYPE OF MAMMALIA EDUCABILIA.

I trust that I have made it sufficiently obvious that the primitive genera of this division of mammals must have been Bunodonts with pentadactyle plantigrade feet. It therefore follows that *Elephas* was not the descendant of *Eobasileus* nor *Bathmodon* in a direct line, but from some common ancestor with tubercular teeth, through *Mastodon*. We may anticipate the discovery of such a genus, and believe that it will not be widely removed from the Eocene *Hyopsodus*, or perhaps *Achænodon*. This will then be the primitive ungulate.

But it will be more than this; it cannot be far removed from the primitive carnivore and the primitive quadrumane. The carnivora are all modified bunodonts, and the lower forms (*Ursus Procyon*, e. g.) are pentadactyle and plantigrade. As to the *Quadrumana*, man himself is a pentadactyle plantigrade bunodont. This view has been already expressed, as follows: "The type of *Tomitherium*, already described, evidently stands between lemurine monkeys and such small allies of *Palæotheriidae* with conic tubercular teeth (*Oligotomus*, *Orotherium*, etc.), and which abound in the Eocenes of Wyoming. . . . The dentition of the two types is, indeed, but little different in the Quadrumanous and Ungulate types respectively, being a continuous series of I. 1 or 2; C. 1; P. m. 3—4; M. 3; the canines but moderately developed."* Such a hypothetical type might be expressed by the name *Bunotheriidae*, with the expectation that it will present subordinate variations in premolar, canine, and incisor teeth. The premolars might be expected to differ in the degree of development of the internal lobes, the canine in its proportions, and the incisors in their number.

In respect to the limbs proper, neither the *Quadrumana* nor *Carnivora* attain to the specialization seen in the *Artiodactyla* and *Perissodactyla*, for the ulna and fibula are never atrophied nor co-ossified with the radius and tibia, but are always distinct and free; the only modification of structure in these points being the slight one involved in developing the rotary capacity seen in the higher monkeys.

Thus the human series preserves in its feet, limbs, and dentition, more of the characteristics of the primitive *Bunotherium*, than any other line of descent of the *Mammalia Educabilia*. It even exhibits a retrogression, in the transition from the anisognathous *Tomitherium* to the genus *Homo*, where the teeth in the two jaws are exactly alike, as well as in the resumption of the continuity of the dental series after the diastema had prevailed among the higher monkeys. In one respect it has steadily advanced, viz., in the number of convolutions and extent of the cerebral hemispheres and relative size of the brain as a whole.

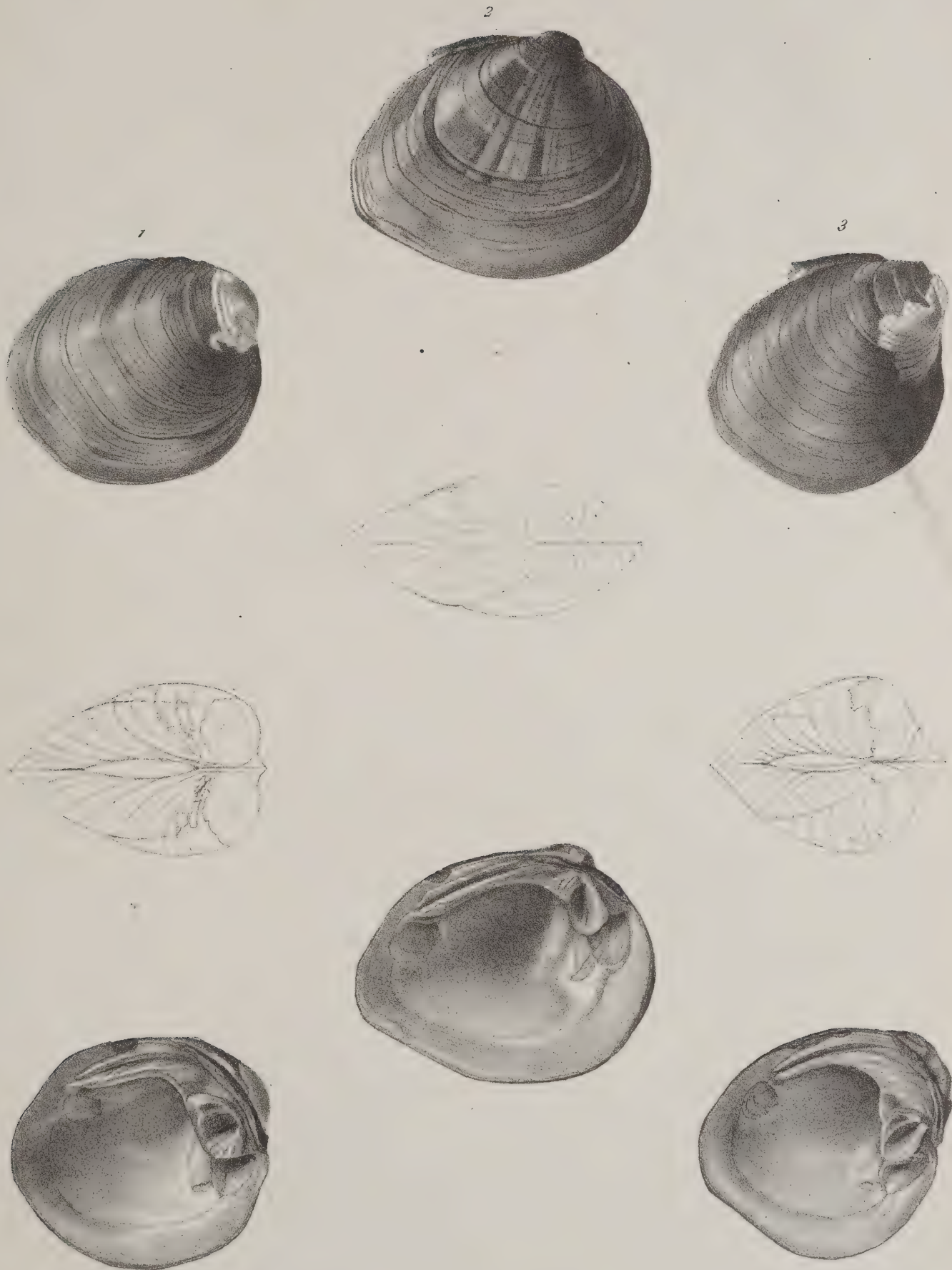
* Hayden's Geological Survey of Montana, etc., 1872, p. 645.

NOTE.—The extinct genera of American formations alluded to in this paper, have been mostly brought to light through the explorations of the Territories under Dr. F. V. Hayden, U. S. Geologist.

LIST OF WOOD-CUTS.

- Fig. 1. Tooth of *Globicephalus*. From Cuvier.
Fig. 2. Teeth of *Jaculus hudsonicus*. From Cuvier.
Fig. 3. *Leptochærus spectabilis*. From Leidy.
Fig. 4. *Rhinocerus crassus*. From Leidy.
Fig. 5. *Achænodon insolens*, Cope.
Fig. 6. *Hippopotamus amphibius*. From Cuvier.
Fig. 7. *Anthracotherium velaunum*. From Blainville.
Fig. 8. *Procamelus robustus*. From Leidy.
Fig. 9. *Merychys major*. From Leidy.
Fig. 10. *Hyopotamus americanus*. From Leidy.
Fig. 11. *Tapirus malayanus*. From Cuvier.
Fig. 12. *Mastodon angustidens*. From Cuvier.
Fig. 13. *Tetracaulodon ohioticus*. From Cuvier.
Fig. 14. *Dinotherium giganteum*. From Cuvier.
Fig. 15. *Elephas indicus*. From Cuvier.
Fig. 16. *Limnotherium elegans*. From Leidy.
Fig. 17. *Hyopsodus paulus*. From Leidy.
Fig. 18. *Palæosyops lævidens*. From Leidy.
Fig. 19. *Anchippodus minor*. From Leidy.
Fig. 20. *Palæosyops major*. From Leidy.
Fig. 21. *Palæotherium crassum*. From Cuvier.
Fig. 22. *Hipposyus formosus*. From Leidy.
Fig. 23. The same, worn upper molar. From Leidy.
Fig. 24. *Hypohippus affinis*. From Leidy.
Fig. 25. *Equus excelsus*. From Leidy. Upper.
Fig. 26. *Equus excelsus*. From Leidy. Lower.
Fig. 27. *Bathmodon radians*, Cope.
Fig. 28. *Uintatherium robustum*. From Leidy. Last upper molar.
Fig. 29. The same, last lower molar.

Published March 30, 1874.



1 *Unio globatus*.
2 *Unio validus*.
3 *Unio subglobatus*.



4 *Unio Lawii*.
5 *Unio obuncus*.
6 *Unio recurvatus*.



7 *Unio Tuscumbiensis*.
8 *Unio appressus*.
9 *Unio radiosus*.



10 *Unio crudus*.
11 *Unio circumactus*.
12 *Unio pallinoides*.



13 *Unio litus*
14 *Unio Cahabensis*
15 *Unio similans*

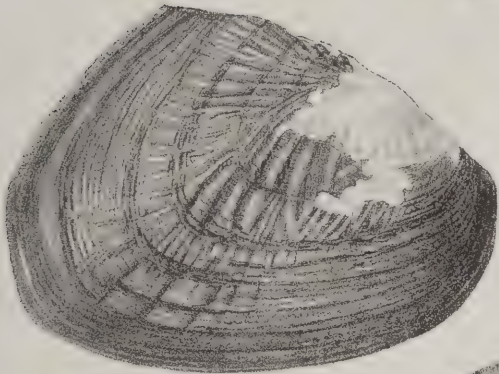


16 *Unio dispansus*
17 *Unio Santeënsis*
18 *Unio radiolus*

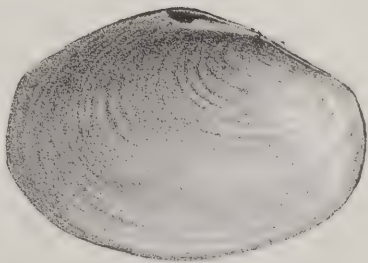
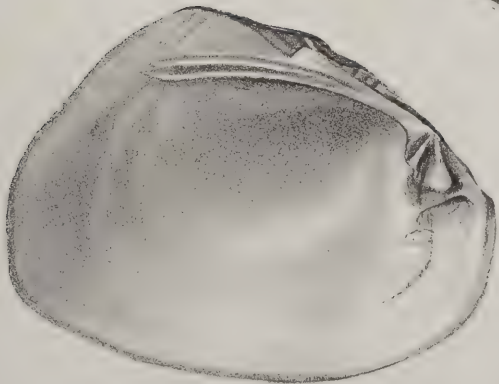
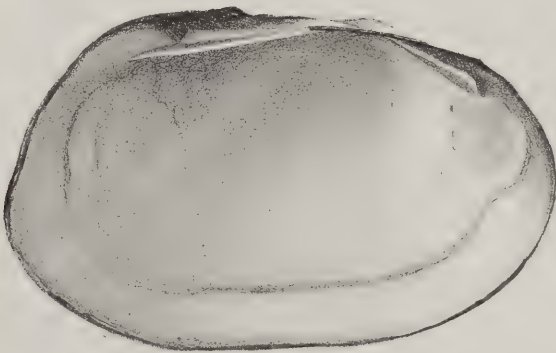
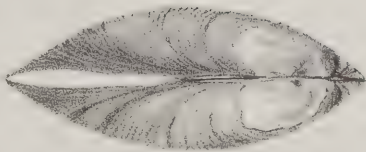
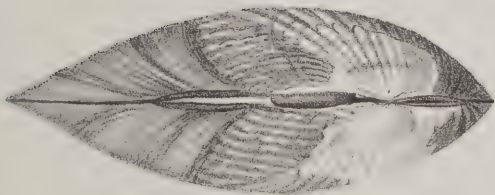
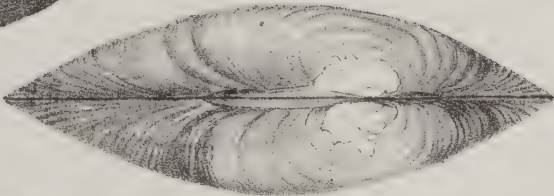
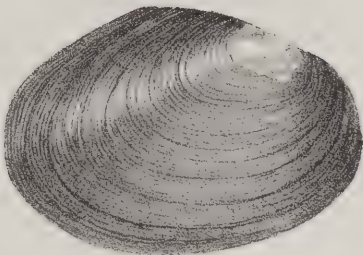
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19



21



19 *Unio Stevensii*.
20 *Unio Jeffreysianus*.
21 *Anodonta exilis*.



22 *Unio Macneili*.

23 *Unio Pealei*.

24 *Unio acutus*.

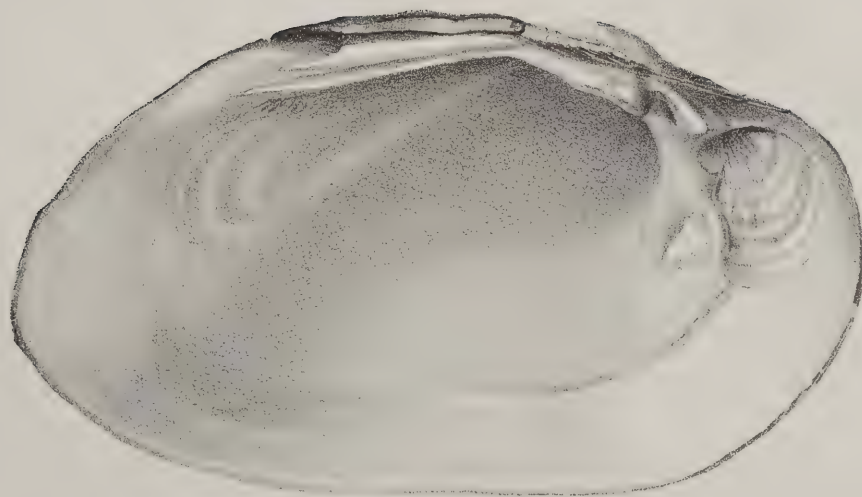
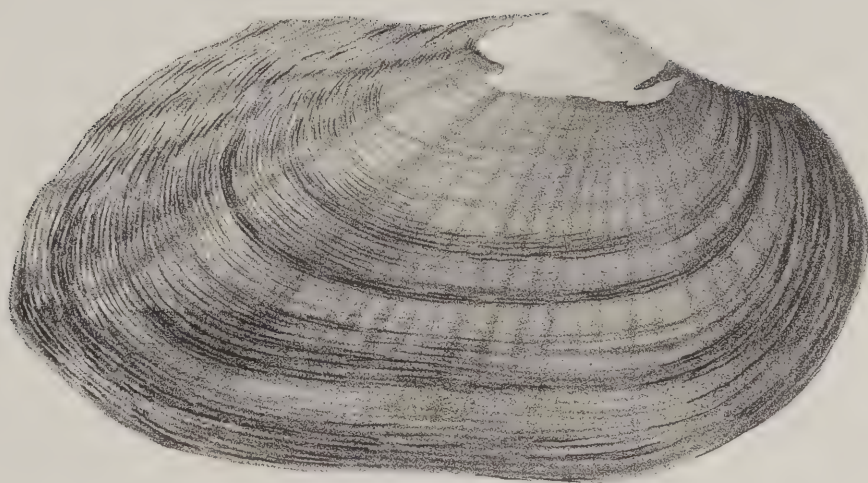


25 *Unio flavidus*
26 *Unio pauciplicatus*.
27 *Unio lenticularis*.

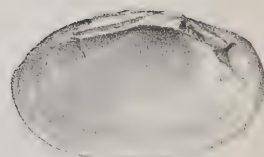
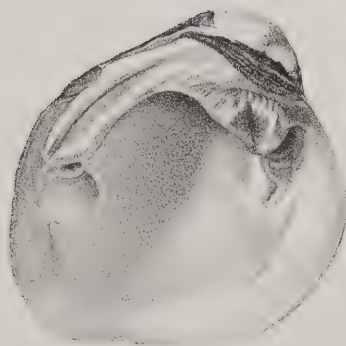
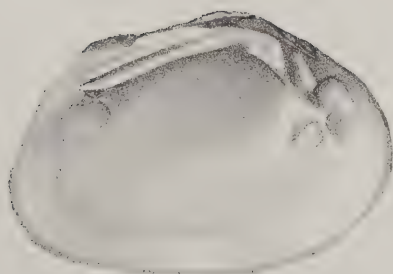
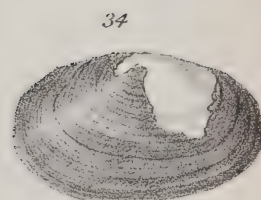
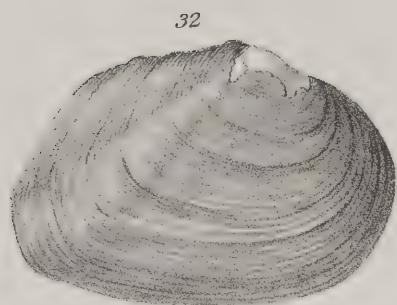


28 *Unio Tellicoensis*.
29 *Unio Yadkinensis*.
30 *Unio Canasaugaensis*.

31



31 *Unio conspicuus*.

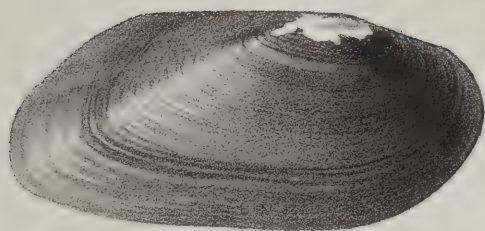


- 32 *Unio brevis.*
33 *Unio Andersonensis.*
34 *Unio vesicularis.*

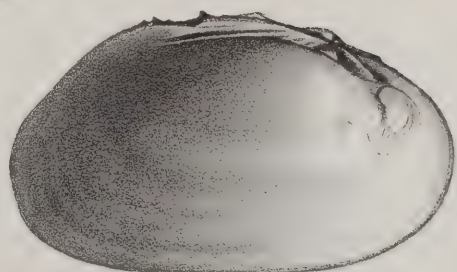
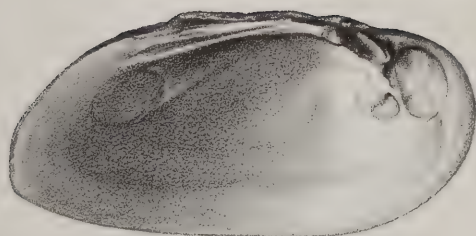
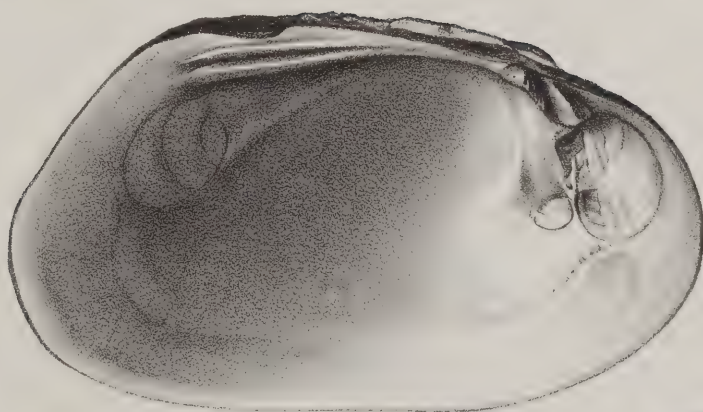
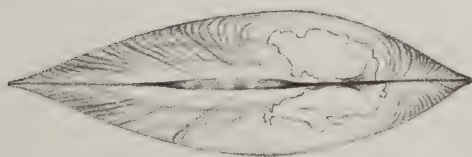
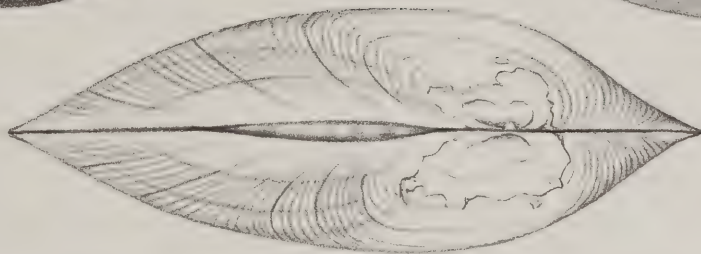
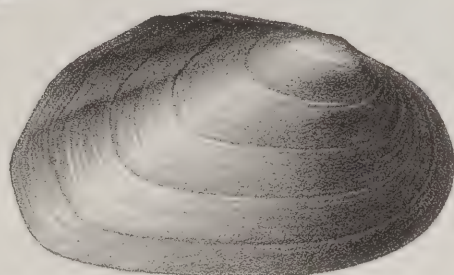
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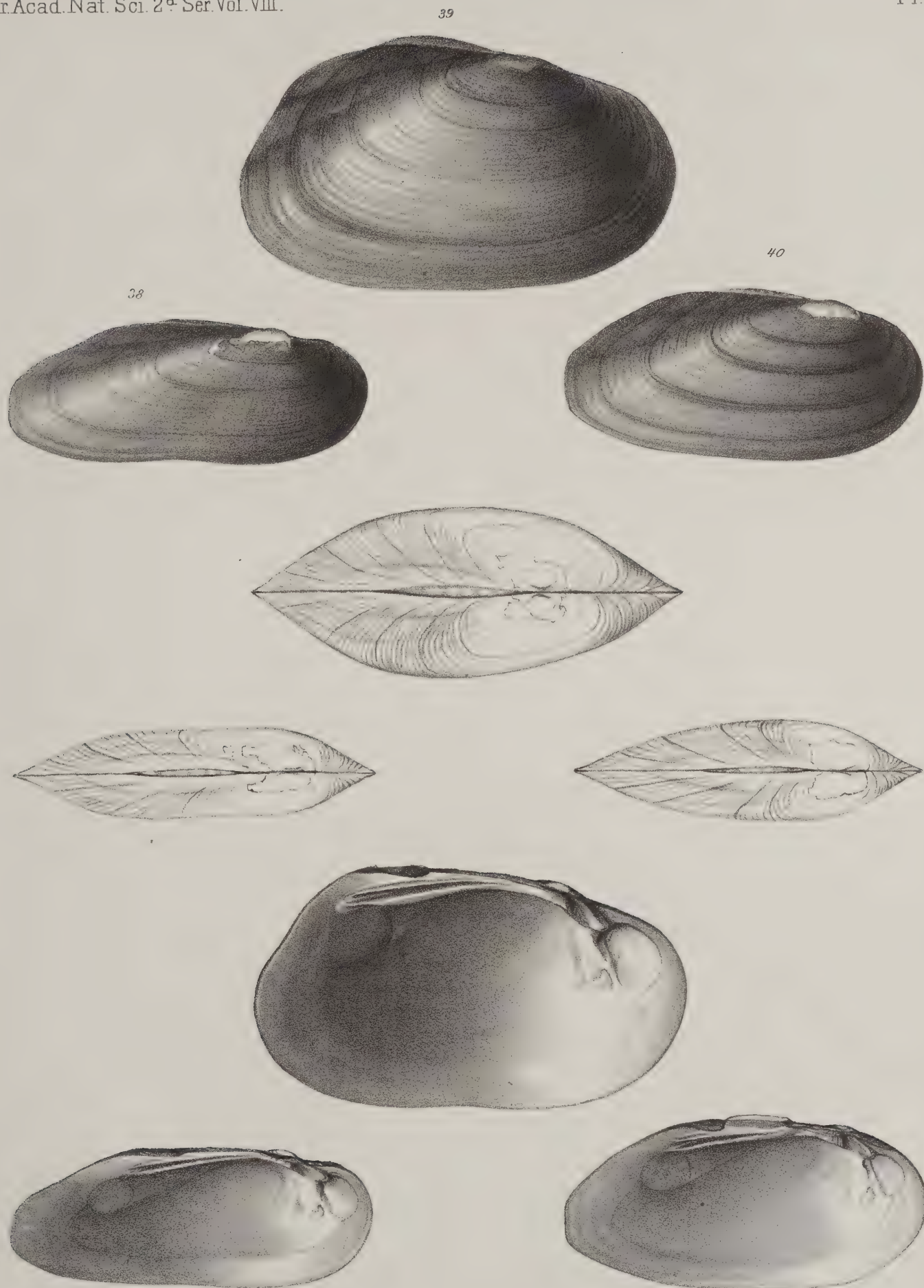
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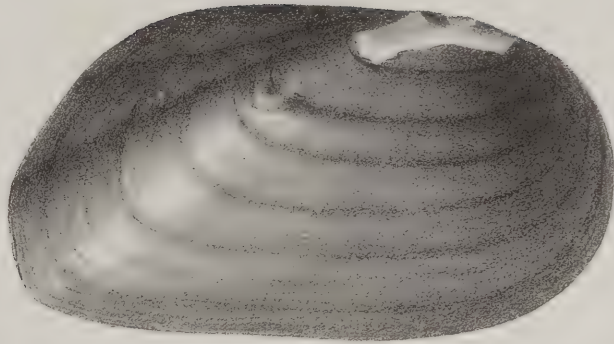


35 *Unio curvatus*.
36 *Unio amplus*.
37 *Unio insolidus*.

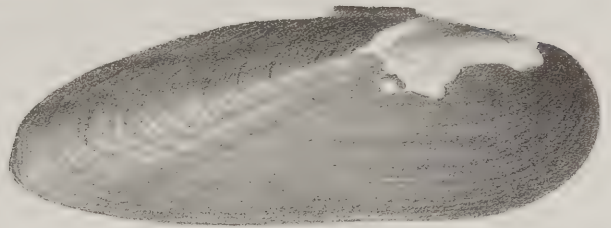


38 *Unio attenuatus*.
39 *Unio differtus*.
40 *Unio cuspidatus*.

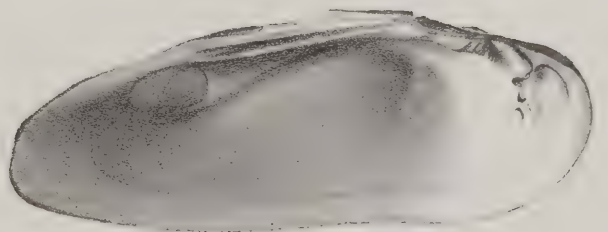
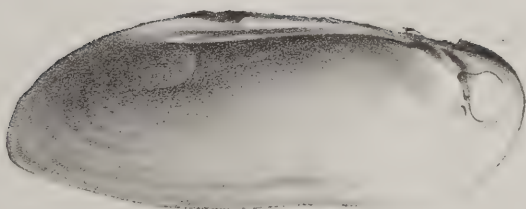
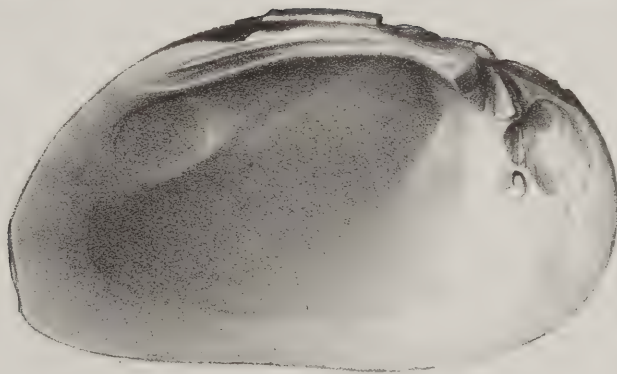
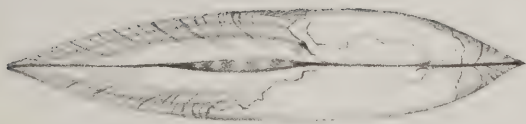
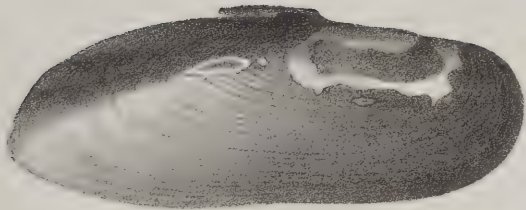
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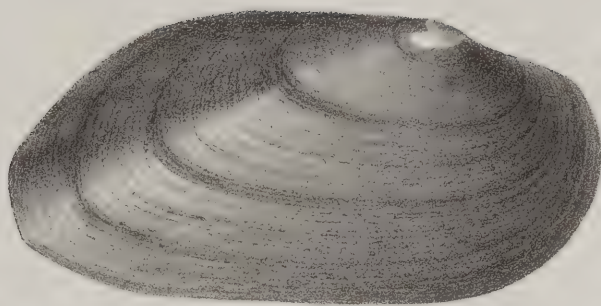


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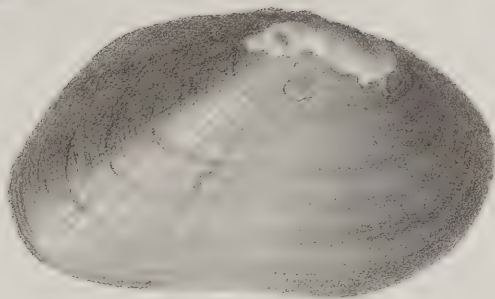


41 *Unio rostellum*.
42 *Unio Irwinensis*.
43 *Unio exacutus*.

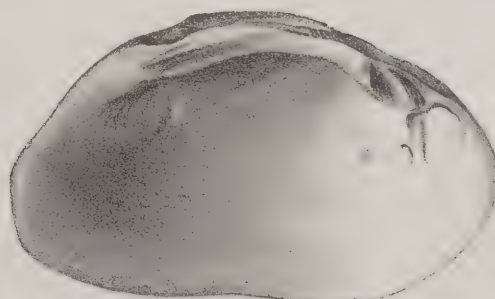
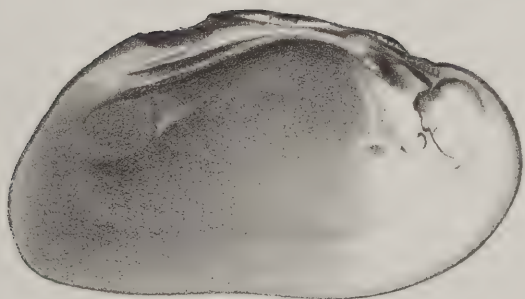
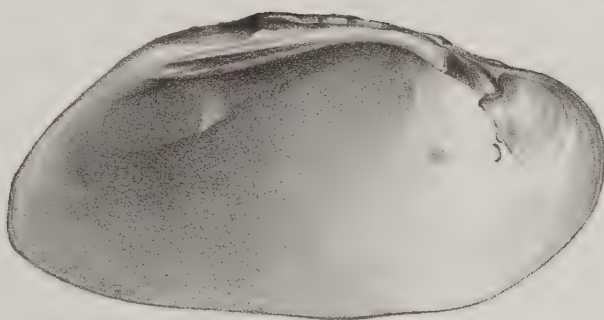
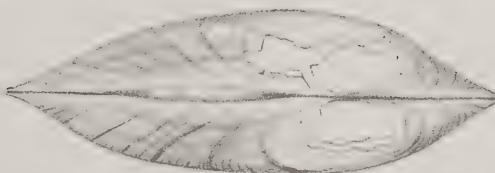
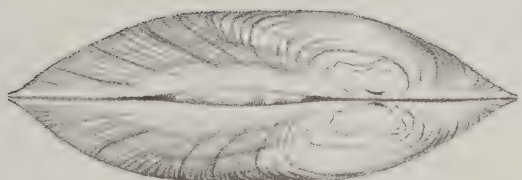
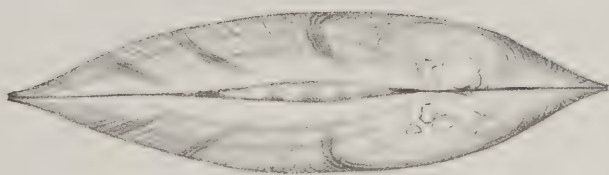
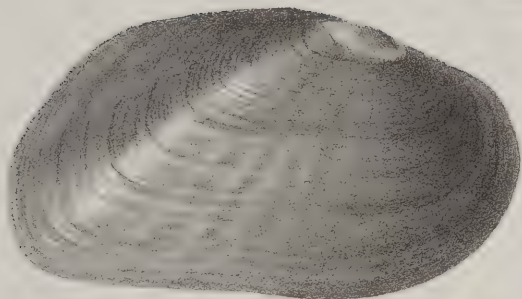
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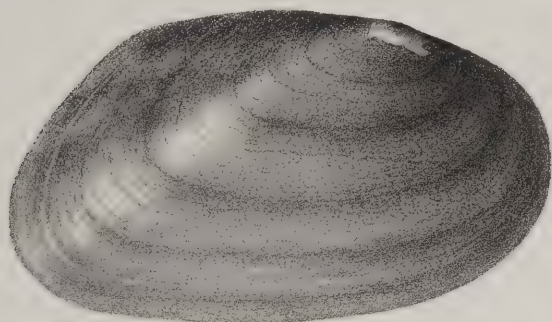


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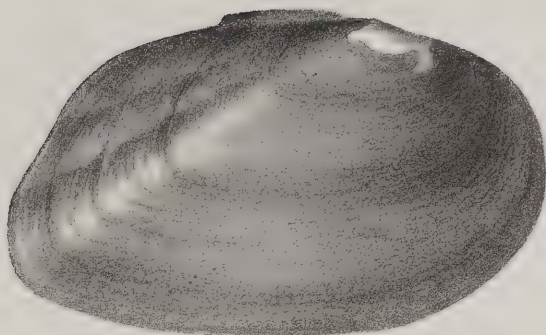


44 *Unio subparvulus* d'us
45 *Unio subquamosus*.
46 *Unio basalis*

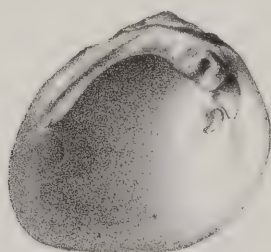
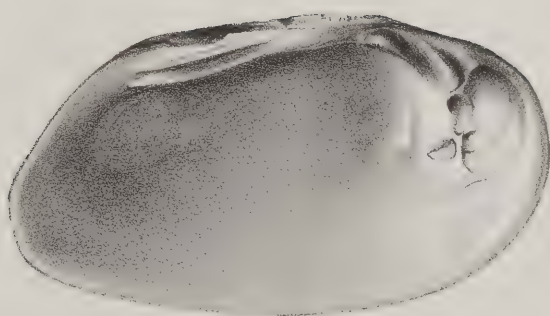
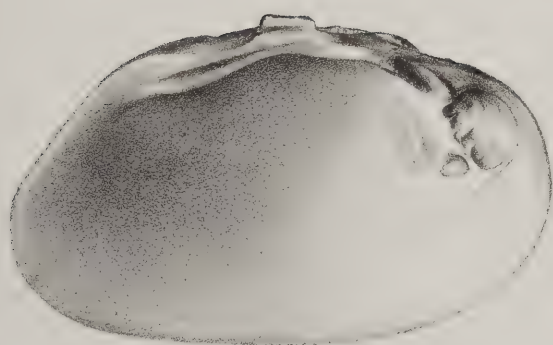
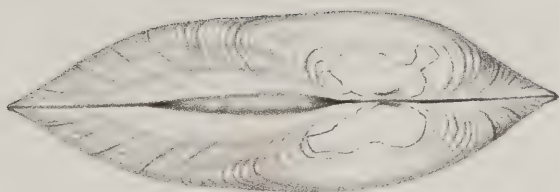
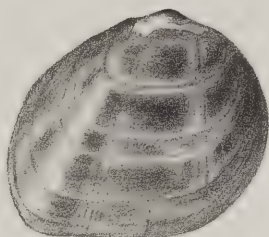
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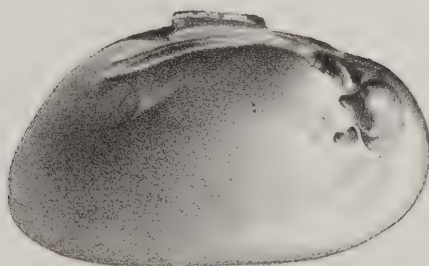
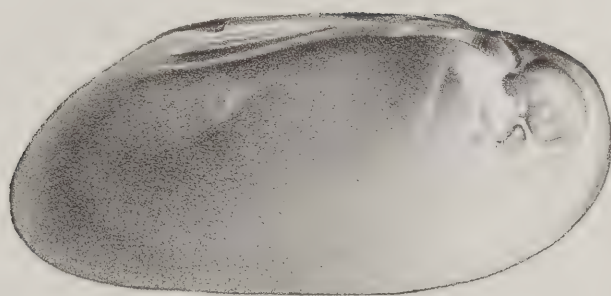
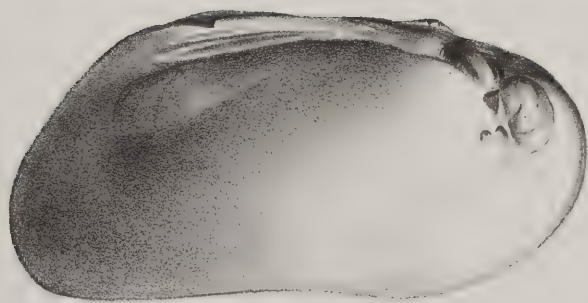
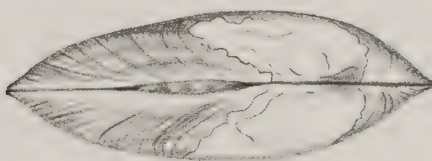
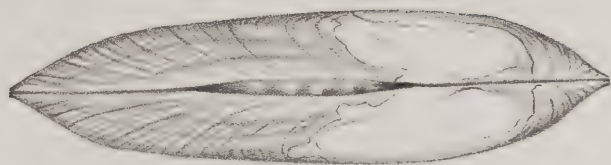
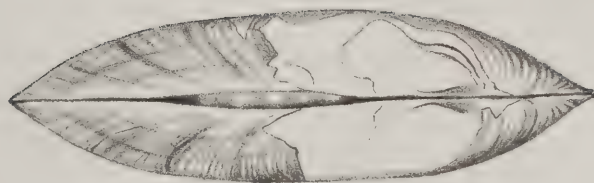
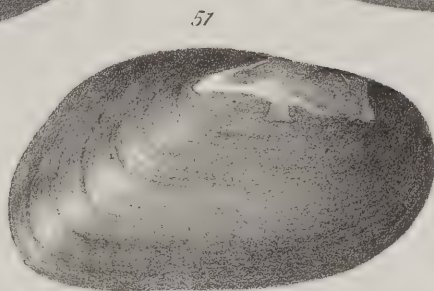
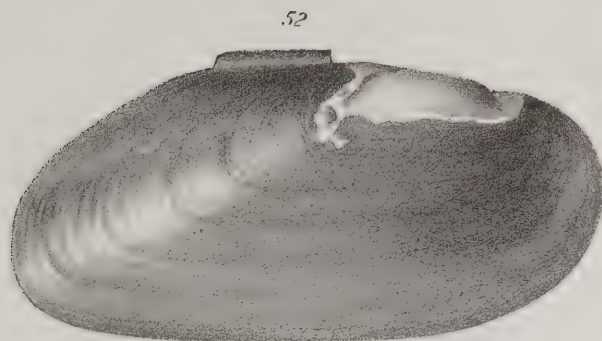
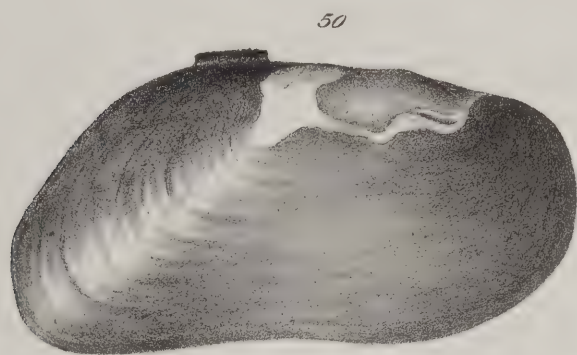
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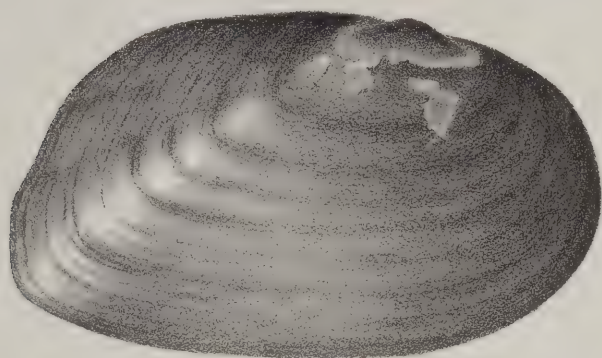


47 *Unio ligatus*.
48 *Unio bellulus*.
49 *Unio infuscus*.

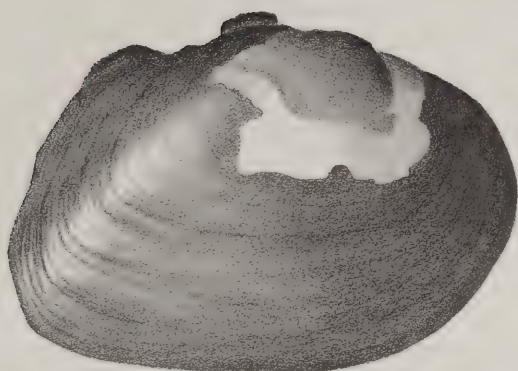


50 *Unio oblongus*.
51 *Unio ratus*.
52 *Unio dissimilis*.

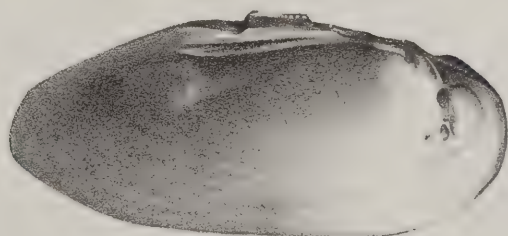
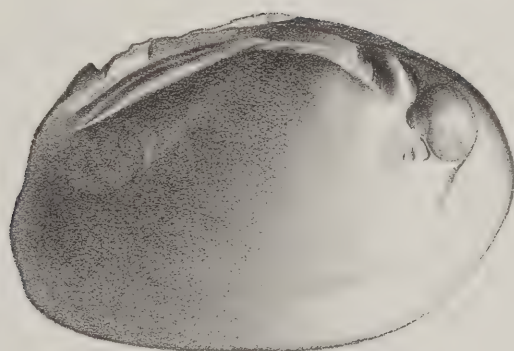
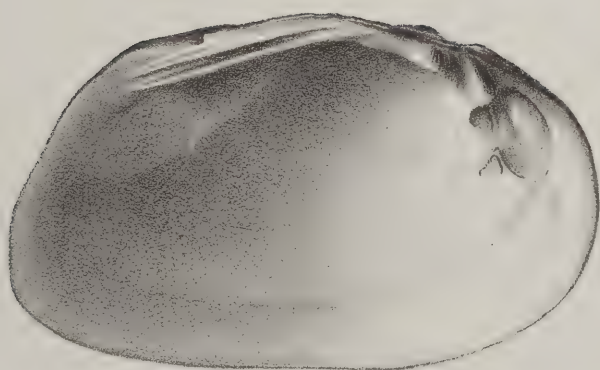
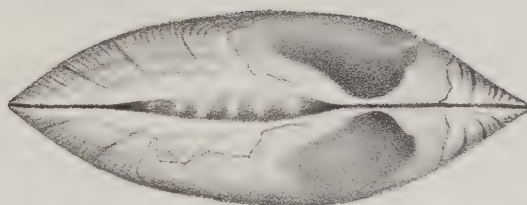
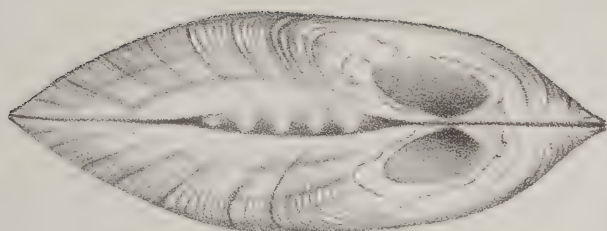
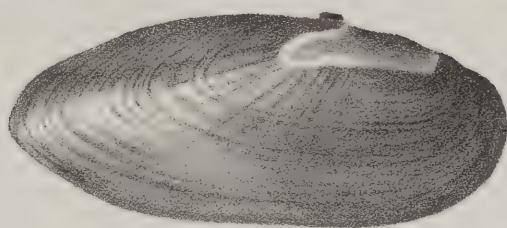
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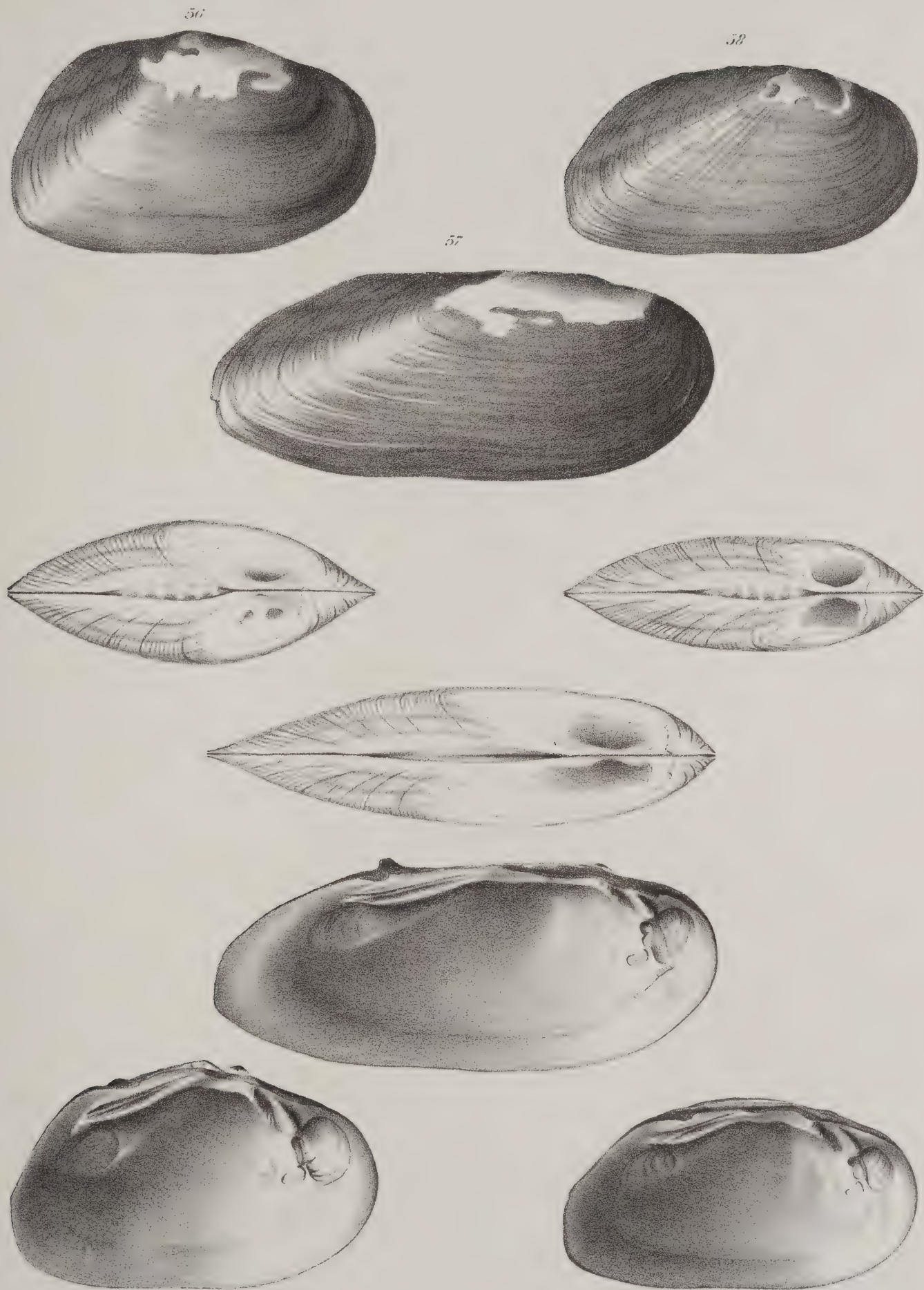
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54



53 *Unio cirratus*.
54 *Unio hastatus*.
55 *Unio strumosus*.



56 *Unio subolivaceus*.
57 *Unio subcylindraceus*.
58 *Unio corneus*.

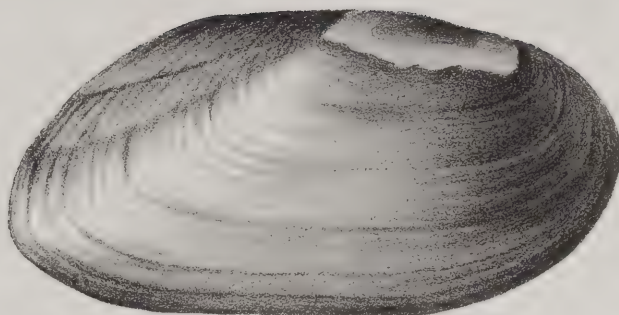


Embryonic form.
59. *Unio infulgens*
1. " *Nashvilleensis*.
2. " *nasutus*.
3. " *parvus*.
4. " *concoloratus*.
5. " *rubellinus*.
6. " *excavatus*.
7. " *sudus*.

Embryonic form.
8. *Unio fallax*.
9. " *Clairbornensis*
10. " *gibbosus*.
11. " *Othelloogensis*
12. " *tortivus*.
13. " *purpuratus*.
14. " *Tippamianus*.
15. *Marj. Spillmanii*

16. *Schizostoma Lévisii*.
17. *Goniobasis Lawrencei*.
18. " *baculoides*.
19. *Physa Carltonii*.
20. " *Wolliana*.

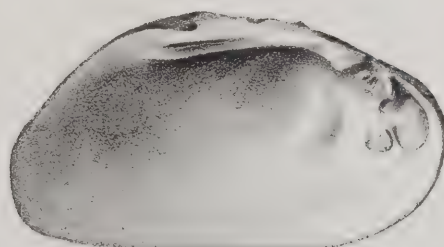
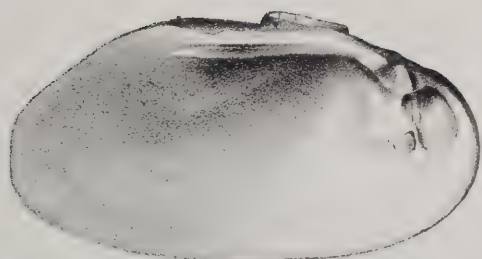
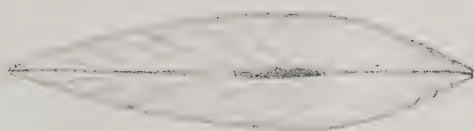
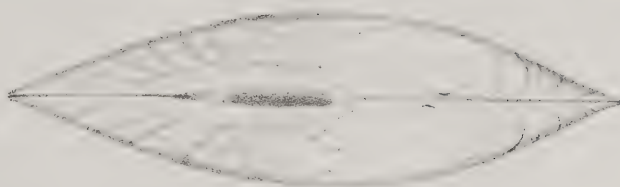
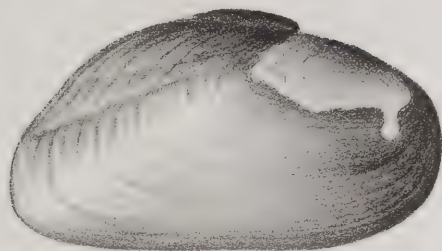
61



60



62



60 *Unio Dooleyensis*.

61 *Unio Gesnerii*.

62 *Unio invenustus*.



ART. IV.—*On the Batrachia and Reptilia of Costa Rica.*

By E. D. COPE.

COSTA RICA, the most southern of the states of Central America, lies between eight and eleven degrees of north latitude, and presents great inequalities of surface. Its length is traversed from northwest to southeast by the range of the Cordilleras, which rise in their highest point, the Pico Blanco, in the southern part of the republic, to an elevation of 11,800 feet. In the middle of the country the range forms the western border of a plateau whose elevation is about 5000 feet, and whose eastern rim is marked by a chain of volcanoes. The principal rivers of the country, which flow into both oceans, take their rise in this plateau. Here also the more important part of the population dwells in the two towns of San José and Cartago.

The climates of the eastern and western regions present material differences. The eastern slope of the country receives the trade-winds loaded with the moisture and clouds derived from the evaporation of the Caribbean Sea under a tropical sun. Constant rain falls on the mountain sides, and the rivers flowing into the Caribbean Sea are remarkable for the volume of water they contain as compared with the length of their courses. The climate of the country west of the mountains is much drier, but not so much so as to constitute aridity. The entire republic, but especially the eastern region, is covered with a dense tropical vegetation.

Dr. Wm. M. Gabb, from whose explorations much of my information is derived, has discovered that the major part of the rocks of the country are of miocene age, and that the elevation of the Cordilleras took place after the close of that period of geologic time. The volcanoes bounding the plateau on the east are of later age.

The material on which the present investigations are based consists chiefly of two collections. One made by Dr. Van Patten of San José was derived from the country in the neighborhood of that city. The larger collection, made by Dr. Wm. M. Gabb of Philadelphia, under the auspices of the government of Costa Rica, was obtained in the southern portion of the region of Costa Rica which lies east of the elevated mountain range which traverses that country, and at different elevations on the range itself. According to Mr. Gabb, the most elevated point, the Pico Blanco, in the southern part of the State, rises to the height of 11,800

feet above the sea. The coast region includes a wide belt of swamps, and then gradually rises to a height of two hundred feet at fifteen miles inland. From this point the surface rises rapidly, so that at twenty-five miles the elevation is 2500 feet above the sea. The vegetation of the entire region is exceedingly dense. At an elevation of from 5000 to 7000 feet is the region of greatest precipitation; rain falls here, according to Mr. Gabb, on more than two hundred days of the year, and heavy fogs are of daily occurrence. The surface is often covered with a deep layer of moss, and swamps abound. There is no belt of pines, as in Mexico, but the extreme summits of the peaks are covered with a sparse vegetation consisting chiefly of an *Artemisia* much like that of the Rocky Mountain region of the United States, with whortleberries, a bamboo-like grass, a stunted tree fern, and scattered tufts of grass.

The collections were made at Limon and Old Harbor, on the coast, and from the latter locality inland to the foot of the Pico Blanco, and thence to its summit. The principal inland stations were Sipurio, fifteen miles from the coast, elevated 200 feet, and Uren, twenty-five miles, elevated 2500 feet. Opportunity being thus offered for determining their hypsometrical distribution, I give the following lists of species which occur at different elevations. Thus certain species do not occur further inland than ten miles from the coast; these are: *Dendrobates typographus*; *D. tinctorius auratus*; *D. talamancae*. *Bufo auritus* is a coast species. From Sipurio we have nearly all the snakes and lizards, and the following Batrachia: *Hyla gabbii*, *H. uranochroa*, and *H. elæochroa*; *Bufo hæmatiticus*. From between this point and Old Harbor came *Mococa assata* and *Opheobatrachus vermicularis*. From Uren, *Cranopsis fastidiosus* and *Tryphlopsis chrysoprasinus*. From higher points on the Pico Blanco, chiefly in the rainy zone, at from 5000 to 7000 feet, we have the following list:—

BATRACHIA.

Opheobatrachus vermicularis, Gray.
Ædipus morio, Cope.
Crepidius epioticus, Cope.
Ollotis cærulescens, Cope.
Atelopus varius, Stann.
Hyla nigripes, Cope.
Hyla punctariola, Peters.
Phyllobates hylæformis, Cope.
Lithodytes podiciferus, Cope.
Lithodytes muricinus, Cope.

Lithodytes habenatus, Cope.
Lithodytes melanostictus, Cope.
Lithodytes megacephalus, Cope.
Lithodytes gulosus, Cope.
Hylodes cerasinus, Cope.
Ranula brevipalmata, Cope.

OPHIDIA.

Catostoma psephotum, Cope.
Contia calligaster, Cope.
Bothriechis nigroviridis, Peters.

Sixteen species of *Batrachia*, three of *Ophidia*, and none of the other orders. On

the summit of the Pico Blanco Mr. Gabb obtained the *Gerrhonotus fulvus* of Bocourt, the only lizard obtained from above the base of the mountains, and the extreme southern point of distribution of the genus *Gerrhonotus*, so far as yet known. It is worthy of remark that the elevated regions between 2500 and 7000 feet are the habitat of four genera with rudimentary auditory apparatus, while but one (*Atelopus*) presenting that character was discovered by Mr. Gabb in the lower country. Three of the four genera of frogs with imperfect organs of hearing known from South America, viz.: *Alsodes*, *Phrynobatrachus*, and *Telmatobius*, are also from mountainous regions.

The Aguacate Mountains to the west of the plateau furnished a species of lizard to the collection, the *Chalcidolepis metallicus*.

The collection obtained by Mr. Gabb embraces eighty-nine species, viz.: *Testudinata*, 5; *Lacertilia*, 19; *Ophidia*, 35; and *Batrachia*, 30. The number of species not previously known to science is thirty-seven. A report on a collection made by Dr. Van Patten in the valley of central Costa Rica was published by the writer in the Proceedings of the Philadelphia Academy for 1871, p. 204, which included forty-six species. Of these twenty-six do not occur in Mr. Gabb's collection. The names of these species are as follows:—

BATRACHIA.

Agalychnis moreletii, Dum.
Smilisca baudinii, Dum. Bibr.

LACERTILIA.

Phyllodactylus.
Cyclura acanthura, Wieg.
Sceloporus malachiticus, Cope.
Anolis hoffmannii, Peters.
Anolis nannodes, Cope.
Anolis insignis, Cope.
Anolis microtus, Cope.

OPHIDIA.

Epicrates cenchria, L.
Colobognathus dolichocephalus, Cope.
Colobognathus brachycephalus, Cope.
Colobognathus hoffmannii, Peters.
Colobognathus nasalis, Cope.

Colosteus rhodogaster, Cope.
Ninia atrata, Hallow.
Ninia sebæ, D. B.; *maculata*, Pet.
Tantilla melanocephala, L.
Rhadinæa serperaster, Cope.
Conophis lineatus, Dum. Bibr.
Liophis epinephelus, Cope.
Herpetodryas carinatus, L.
Drymobius margaritiferus, Schl.
Dipsas gemmistratus, Cope.
Thrasops mexicanus, D. B.
Dryiophis brevirostris, Cope.
Pelamis bicolor, Daud.
Elaps multifasciatus, Jan.
Elaps ornatissimus, Jan.
Elaps nigrocinctus, Gird.
Bothriechis affinis, Boc.
Crotalus durissus, L.

A number of species, chiefly batrachians, have been sent to the Smithsonian Institution by C. N. Riotte, which are of considerable interest. In addition to the collections sent to the United States, others have been sent to Europe, and

have been the objects of study by M. Bocourt of Paris, Peters of Berlin, Günther of London, and Keferstein of Göttingen. The explorers who have furnished the material to these herpetologists have been Messrs. Hoffmann, Salvin, and Seebach. The total number of species known from the investigations, now amounts to one hundred and thirty-two. But many species have been described from the adjoining states of Nicaragua and Chiriqui, and from Veragua, adjoining the latter, of which many will be found to enter Costa Rica also. Thus it is evident that this region is very rich in terrestrial cold-blooded vertebrata. The State of Costa Rica is about equal in extent to that of South Carolina.

BATRACHIA.

GYMNOPHIONA.

1. SIPHONOPS MEXICANUS, Dum. Bibr., viii. 284.

From the forest country near the coast at Limon.

URODELA.

2. OPHEOBATRACHUS VERMICULARIS, Gray, Ann. Mag. Nat. Hist. 1868, 297. *Ædipina uniformis*, Keferstein, Archiv. für Naturgesch., 1868, 299.

Three specimens, one from the Pico Blanco, at 6000 feet elevation, of large size, measuring m. .162 in length. The cranium of this one is completely ossified above, but the choanæ are not isolated, but open into the orbit by a wide fissure. The two other specimens are from the lower country, twenty miles from the coast.

3. *ÆDIPUS MORIO?* Cope, Proc. Academy Philadelphia, 1869, p. 103.

A partly preserved specimen from the eastern slope of the Pico Blanco.

ANURA.

BUFONIFORMIA.

4. CRANOPSIS FASTIDIOSUS, Cope, gen. et sp. nov. Bufonidarum.

Char. Gen.—No ostia-pharyngea nor tympanum; no vomerine teeth. Cranial integument entirely occupied by a rugose ossification; parotoid glands present. Fingers and toes distinct, the latter palmate.

This genus is *Peltaphryne*, Cope, with the auditory apparatus wanting. *Char. spec.*—Size of the *Bufo lentiginosus*. The head wide, not depressed, the cranial ridges consisting of elevated canthus rostralis, supra- and post-orbital border and a supra-tympanic crest extending to the parotoid gland. These, especially the last, are obtusely thickened. The supra-tympanic crest is produced downwards

behind the orbit as a rugose osseous plate to opposite the inferior border of the pupil of the eye, bounding the position usually occupied by the membrum tympani by a rough concave margin. The canthus rostrales are short and inclose a groove between them; the loreal and labial regions are rugose with small tubercles. The profile of the muzzle descends abruptly to the lip, which it does not overhang. The nostrils are as far removed from each other as each one is from the orbit. The posterior outline of the cranial ossification is squarely truncate in adults.

The parotoid glands are short, subtriangular, sublateral, and as deep as long. They are not continued into a fold. The upper surfaces of the body and limbs are studded with round warts, so closely on the latter region as to resemble a pustular disease. A row of larger tubercles extends from the parotoid gland to the axilla. The inferior surfaces support numerous smaller tubercles. The fingers are short and free, and the palmar tubercles are very obtuse. There are neither tarsal folds nor tubercles, those of the sole being very obscure. Toes half-webbed. The end of the longest toe reaches the end of the muzzle when the limb is extended, and the longest finger reaches the vent.

The color above is yellowish-brown; below, dirty-brown. A blackish band extends from the parotoid to the axilla, the color not affecting the apices of the tubercles in its course, and sometimes extending to the abdomen. Throat with a black spot; top of head yellow or brownish-yellow.

	M.
Length of head and body . . . . .	.058
“ to orbit . . . . .	.005
“ to posterior border of cranium . . . . .	.016
“ to axilla . . . . .	.023
“ of fore limb . . . . .	.035
“ of hand . . . . .	.013
“ of hind limb . . . . .	.060
“ of hind foot . . . . .	.035

Several specimens from 2500 feet elevation on the slope of the Pico Blanco, in the district of Uren.

5. *CREPIDIUS EPIOTICUS*, Cope, gen. et sp. nov. *Buфонidarum*.

Char. Gen.—No ostia-pharyngea, membrum tympani, nor vomerine teeth; parotoid gland present. Cephalic derm not occupied by ossification. The digits of all the feet inclosed in the skin, leaving the longest median toe projecting; inner digits of both feet rudimental.

In this new genus the structure is much as in *Atelopus*, resembling also, but in

less degree, the genus *Oedipus* of the salamanders. In other respects the form is that of *Ollotis*, Cope.

Char. Specif.—Size medium; cranial crests consisting of supra-tympanic, supra-orbital, and canthal ridges, the last two continuous with each other and extending in a nearly straight line to the nares, with a slight thickening opposite the front of the orbit. The intervening concave surface is of moderate width. The superciliary ridges send inwards a short tuberosity at the posterior third of the orbit. The supra-tympanic is short and very protuberant, giving the cranium an angulate outline. There is a low, narrow, post-orbital ridge. No trace of membranum tympani. Parietal region with several small osseous nodules on each side. Parotoid very small, subround. Skin everywhere rugose with minute tubercles, which are sparse on the dorsal, dense on the ventral, regions. Soles smooth, no tarsal, carpal, or solar tubercles or folds. Longest digit on both extremities projecting 2.5 phalanges beyond the flat mass which includes the other digits. Femur half-inclosed in inguinal integument. A concave dermal fold from end of each sacral diapophysis to parotoid gland, which is easily obscured.

	M.
Length of head and body . . . . .	.035
“ to orbit . . . . .	.004
“ to angle of jaw . . . . .	.011
“ to axilla . . . . .	.017
“ to groin . . . . .	.030
“ of fore limb . . . . .	.019
“ of fore foot . . . . .	.007
“ of hind limb (free portion) . . . . .	.030
“ of hind foot . . . . .	.018

General color black, above a little lighter with a few darker spots on each side; soles yellowish; entire scapular region brown; sometimes a brown median dorsal band.

From 5000 feet elevation on Pico Blanco.

6. *OLLOTIS CÆRULESCENS*, Cope, gen. et sp. nov. *Buфонidarum*.

No ostia-pharyngea nor membranum tympani. Parotoid glands present. Digits free on all the feet. Cranial derm not occupied by ossification.

This genus may be regarded as *Bufo* with the auditory apparatus incomplete, agreeing in this respect with the preceding genera *Crepidius* and *Cranopsis*.

Char. Specif.—The largest specimen is about an inch in length, and hence perhaps not adult, although there are no marks of immaturity observable. There

are no cranial ridges except a protuberant supra-tympanic; the superciliary ridges are slightly prominent and continued behind in straight lines by two angles of the parietal bone. No trace of *membrum tympani*. The *canthus rostrales* are straight and angular, and the lores elevated; the nares are nearer to each other than each is to the orbit. The tongue is large and elongate. The skin of the back and sides is studded with numerous spaced tubercles, and the lower surfaces are nearly smooth. There is no tarsal fold, and the palmar and plantar tubercles are obsolete. The digits are all distinct, those of the hind foot half-webbed. The wrist of the fore limb, and the end of the second toe of the hind limb extended, reach the end of the muzzle.

	M.
Length of head and body . . . . .	.025
Width of head behind . . . . .	.008
Length to orbit . . . . .	.003
“ to axilla . . . . .	.010
“ to groin . . . . .	.021
“ of fore limb . . . . .	.014
“ of fore foot . . . . .	.005
“ of hind limb . . . . .	.023
“ of hind foot . . . . .	.013

Upper surfaces blackish, the tubercles brown; below black, thickly marked with light blue spots.

From 3000 to 5000 feet elevation on Pico Blanco.

7. *BUFO AURITUS*, Cope, sp. nov.

Vertex flat, bounded by a vertical superciliary crest on each side, which is slightly bent where it gives off the post-orbital crest, and then continues to the posterior border of the cranium. Post-orbital ridge prominent, presenting an open angle where it gives off the supra-tympanic, particularly prominent as the anterior border of the tympanic membrane. Supra-tympanic horizontal, prominent. Supra-orbital crests abruptly incurved at the loreal region, and separated by a narrow groove at the summit of the muzzle. No preorbital crest. End of muzzle narrow, produced beyond the line of the upper lip; external nares nearer each other than the orbit. Parotoid gland quite small, surmounted by several dermal spines. Tubercles of the skin small, spinulose, most numerous on the sides, wanting below. Tarsus without fold, spinulose; palmar and solar tubercles insignificant. Digits elongate, the fingers remarkably so; the toes half-webbed. The wrist reaches beyond the end of the nose, as does also the heel of the extended hind limb. The

membranam tympani is distinct in its anterior half, and the ostia-pharyngea are minute.

	M.
Length of head and body . . . . .	.031
Width of head behind . . . . .	.010
Length to orbit . . . . .	.004
“ to posterior border skull . . . . .	.010
“ to axilla . . . . .	.015
“ to groin . . . . .	.026
“ of fore limb . . . . .	.023
“ of fore foot . . . . .	.010
“ of hind limb . . . . .	.038
“ of hind foot . . . . .	.021

Color brown; a quadrate patch on vertex from orbits to occiput, an oblique band from the latter outwards on each side, and a spot on each lateral sacral region black. Belly marbled with black; throat and limbs below, dusky.

This species resembles in its general appearance the *Crepidius epioticus*, Cope, but differs in many points, both generic and specific. It is also allied to the *Bufo veraguensis*, Schmidt, but according to that author the supra-tympanic crest is much smaller than in *B. auritus*.

Two specimens from the East coast region.

8. BUFO VALLICEPS, Wieg. *B. nebulifer*, Girard, U. S. Mex. Boundary Survey, II. (2) 25, Pl. XL. f. 1.

A variety with narrow cranial crests, and less fully webbed toes; the ground color is light, and is marked with large black spots forming a row on each side of the median line. Throat and breast black, pale spotted.

9. BUFO COCCIFER, Cope. Proceed. Acad. Philada., 1866, p. 130.

Parotoids round semi-globular. Muzzle narrowly rounded, nearly as long as orbit. Strong bony, canthal, pre-, sub-, and post-orbital, supra-tympanic and supra-orbital ridges; the last regularly curved and sending a parietal branch towards the median line; the first rapidly converging, leaving only a gutter between. Tympanum one-fifth orbit. Everywhere minutely tubercular, those of the sides and forearm conic; soles rough, web short, metatarsal tubercles small, obtusely prominent; tarsal fold scarcely visible. Heel to axilla. Two obtuse metacarpal warts.

Gray-brown; a yellow vertebral line, with numerous chestnut-brown light bordered spots on each side. Sides with two longitudinal brown bands; one from

parotoid and one from groin. Limbs irregularly light varied above. Under surface immaculate.

Length of head and body 2 in. 6 l.; breadth at angle of jaws below, 1 in.; length of fore limb 1 in. 5 l.; length of foot 1 in. 3 l.

C. N. Riotte. Smithsonian collection, No. 6490.

This handsome species resembles the *B. ocellatus*, Gthr., in coloration.

10. *BUFO STERNOSIGNATUS*, Günther, Catal. Batrach. Salientia Brit. Mus. 1858, p. 68.

Said to have been found in Costa Rica by Keferstein, Archiv. für Naturgeschichte, 1868, 294.

11. *BUFO AGUA*, Daudin.

Large and small specimens from the Eastern coast. This species is especially abundant about houses.

12. *BUFO HÆMATITICUS*,* Cope, Proceed. Acad. Philadelphia, 1862, 157. Sipurio.

FIRMISTERNIA.

13. *HYPOPACHUS VARIOLOSUS*, Cope. *Engystoma variolosum*, Cope, Proceed. Acad. Philada. 1866, p. 131; Proceed. Amer. Philos. Soc. 1869, p. 166. *Hypopachus seebachii*, Keferstein, Nachrichten Göttingen, 1867, p. 352; Archiv. f. Naturgeschichte, 1868, Tab. IX., figs. 1, 2.

The genus *Hypopachus* resembles *Engystoma*, but differs in the important particular of the possession of a clavicle, as was first pointed out by Dr. Keferstein. It is therefore to be referred to the family of the *Phryniscidæ*.

Two strong compressed metatarsal tubercles, a sublongitudinal cuneiform and subtransverse opposite it: toes slightly webbed. Width between tympanic regions nearly double the length from muzzle to nuchal fold. Muzzle prominent, as long as orbit, nostrils nearly terminal. Mandible with two symphyseal notches, and median knob. Tongue flat, elongate; slits of vocal vesicle large. Heel to front of scapula.

Dark brown above; under side, limbs, and belly darker, with numerous large yellowish spots. Sides anteriorly blackish-brown, which color has a serrate margin above. Femora, forearms, and tarsi brown behind, with coarse yellow vermiculations: some yellow spots behind the angle of the mouth. Length of head and body 1 in. 4.5 l.; of posterior limbs 1 in. 7 l.

Chas. N. Riotte. Mus. Smithsonian, No. 6486.

* The *Bufo simus*, Schmidt, Denkschriften K. K. Akademie Wien, 1858, p. 254, will probably be found in Costa Rica.

14. *ATELOPUS VARIUS*, Stannius.

Very abundant both on the Pico Blanco range, and in the lower country. The markings are vermilion on a black, or, in the case of the mountain specimens, a green ground. In some of the latter the red markings are few, and in others altogether wanting, leaving a uniform pea-green.

15. *DENDROBATES TYPOGRAPHUS*, Keferstein, Archiv. f. Naturgeschichte, 1868, p. 298, Pl. IX. fig. 7.

Dendrobates ignitus, Cope, Proceed. Academy, Phila., 1874, p. 68.

The form described by me as *D. ignitus* differs from the one observed by Keferstein, in the uniform red of the dorsal region. Both occur in Mr. Gabb's collection.

From the low country, not more than ten miles inland.

16. *DENDROBATES TINCTORIUS*, Wagl., var. *auratus*, Girard, Steindachner Verhandl. der K. K.

Zool. bot. Gesselsch., Wien, 1864, p. 261.

Numerous, and exclusively from the lower country, not extending far inland.

17. *DENDROBATES TALAMANCÆ*, Cope.

Allied to the *Dendrobates lugubris*, Schmidt, Denkschr. K. K. Akad., Wien, 1858, p. 250.

First finger longer than the second; the skin of the upper surfaces entirely smooth; tympanic membrane very obscure. Head elongate, muzzle depressed, truncate, the nares equidistant from each other and the orbits. When the limbs are extended, the wrist reaches the front, and the heel the middle of the orbit. No tarsal fold; palmar and solar tubercles insignificant.

Color brown above, separated by a border of light pigment from the white of the lower surfaces. This border continues as a light border of the upper lip round the end of the muzzle. Top of muzzle, and a band from the eye to the groin on each side, yellowish. Upper surface of fore limbs yellow. External surfaces of femur and tibia covered with a light pigment. Posterior face of femur black, with a short yellow band on each side directed outwards from behind the groin, forming with the light band of the superior face of the femur, a hook-shaped pattern.

	M.
Length of head and body . . . . .	.022
“ of head to angle jaw . . . . .	.008
Width of head behind . . . . .	.006
Length to orbit . . . . .	.003
“ to axilla . . . . .	.010
“ of fore limb . . . . .	.011
“ of fore foot . . . . .	.005
“ of hind limb . . . . .	.027
“ of hind foot . . . . .	.012

From near Old Harbor on the East coast.

ARCIFERA.

18. *HYLA GABBII*, Cope, sp. nov.

A rather large species resembling the *Smilisca baudinii*, D. B. Vomerine teeth in two short transverse series between the interior nares. Choanæ and ostia pharyngea subequal; tongue round, scarcely free behind. Head short, wide; canthus decided, concave; nares much nearer each other than each one is to the orbit. Membrum tympani less than half the area of the orbit. Integument of upper surfaces nearly smooth. Fingers well webbed to the base of the penultimate phalange of the longest; toes webbed to near the end of the corresponding phalange of the hind foot. Digital dilatations large, about equal to the tympanum. Lower surfaces areolate.

Color ashy-brown, the pigment forming a narrow band on the upper face of the femur. Anterior and posterior faces of femur dusky, without coloration figure. Some large irregular brown spots on the back, groin marbled with light-brown and white. Lip with a faint pale border, no large spots on it or the lores. Tibia and cubitus with broad pale-brown cross-bands; lower surfaces all whitish.

	M.
Length of head and body . . . . .	.056
“ of head to angle of jaws . . . . .	.016
Width of head at angle of jaws . . . . .	.020
Length to orbit . . . . .	.007
“ to axilla . . . . .	.022
“ of fore limb . . . . .	.032
“ of hind limb . . . . .	.093
“ of hind foot . . . . .	.040

This tree-frog resembles the *Smilisca baudinii*, but differs in the absence of the post-orbital process, the more extensive palmation of the fingers, and the absence of the characteristic spots on the upper lip. It is dedicated to William M. Gabb, of the Geological Survey of Costa Rica (formerly of Santo Domingo and of California), to whom herpetological science is indebted for the collection now described.

From near Sipurio.

19. *HYLA URANOCHROA*, Cope, sp. nov.

A species of the size of the *Hyla carolinensis*, and related to it in general structure. The vomerine teeth are in two fascicles exactly between the inner nares, which are small and just equal to the ostia pharyngea in size. Tongue round, little free. The head is wide and the muzzle rounded, the canthus rostralis

obtuse and moderately concave. Nostrils considerably nearer each other than to orbit, which is large and equal to twice the area of the tympanum. The toes are short, and digital dilatations large; the fingers have a short web, which is deeply emarginate; the toes are not fully webbed, the membrane notched to opposite the proximal end of the antepenultimate phalange. Head and body elongate, so that when the limbs are closed the knee and elbow are not in contact. The heel reaches the middle of the orbit, and the longest finger the femur. Skin smooth above, areolate below.

Color above, blue; below ? yellow (whitish pigment in alcohol). The blue pigment is sharply bordered along the sides and extends on the upper surfaces of the humerus and femur, as well as cubitus, tibia, and tarsus, and on the base of the outer finger, and entire surface of outer two toes. Upper lip yellow bordered all round; vent yellow, no inguinal, femoral, labial, or other spots.

	M.
Length of head and body . . . . .	.040
“ to angle of jaw . . . . .	.010
“ to axilla . . . . .	.014
“ to groin . . . . .	.036
Width of head behind . . . . .	.014
Length of fore limb . . . . .	.022
“ of fore foot . . . . .	.010
“ of hind limb . . . . .	.055
“ hind foot . . . . .	.025

From near Sipurio.

20. *HYLA NIGRIPES*, Cope, sp. nov.

A species of the size of *Hyla carolinensis*, with longer head and limbs than the last described species. Vomerine teeth in two short transverse series between the inner nares; the latter equal to the ostia pharyngea. Tongue longer than wide. The head is an oval, but the muzzle does not project; the canthus rostrales are a little concave, and the lores are oblique. The orbits are large and from four to five times the area of the tympanum. The digital dilatations are moderate, the web of the fingers extending about half-way to the end of the longest, notched deeper than the line of the penultimate phalange. Web of toes not extending to end of penultimate phalange. Upper surfaces smooth, the lower finely areolate.

Color dark-brown, limbs and feet blackish. Lip brown, groin finely white and blackish marbled; no lateral border or band. Posterior face of femur black, unspotted; no spots on any other region. Sides of throat black-dusted.

	M.
Length of head and body . . . . .	.039
“ to orbit . . . . .	.005
“ to angle of jaws . . . . .	.011
Width of head at angle of jaws . . . . .	.013
Length of fore limb . . . . .	.024
“ of fore foot . . . . .	.010
“ of hind limb . . . . .	.065
“ of hind foot . . . . .	.016

When the limbs are closed, the knee and elbow overlap some distance. The species in form and sombre colors resembles some of the *Scytopes*, but is a true *Hyla*.

18. *HYLA ELÆOCHROA*, Cope, sp. nov.

A small species with elongate oval head and uniform coloration. The vomerine teeth are entirely between the nares, and form two short series directed backwards towards the middle line; in some specimens the backward inclination is very slight. The choanæ are larger than the ostia pharyngea, and the tongue longer than wide. The muzzle is elongate and plane above, and slightly projecting. The nares are as far from each other as from the lip border, and nearly twice as far from the orbit. Eyes large, four or five times the area of the membrum tympani. Digital dilatations large; fingers entirely free. Toes with emarginate webs not reaching the end of the antepenultimate phalange of the longest toe, which is rather short. Skin above smooth, below finely areolate on the abdomen. Legs long, the heel reaching the end of the muzzle, the wrist not quite reaching the same point.

Color above and below a uniform olivaceous, without spots. A pale area below the eye; lip faintly marbled.

	M.
Length of head and body . . . . .	.026
“ to angle of jaws . . . . .	.009
Width of head at angle of jaws . . . . .	.009
Length of head to orbit . . . . .	.0045
“ to axilla . . . . .	.011
“ of fore limb . . . . .	.016
“ of fore foot . . . . .	.007
“ of hind limb . . . . .	.044
“ of hind foot . . . . .	.019

The pre-frontal bones in this species are unusually wide.

Three specimens from the east foot of the mountains near Sipurio.

19. *HYLA PUNCTARIOLA*, Peters, Monatsberichte K. Preuss. Acad. Wiss. 1863, p. 462.

Five specimens from the Cordilleras, at from 5000 to 7000 feet, agree in essentials with the above-named species, but differ entirely from it in coloration, as well as from each other. Two of the specimens agree with each other exactly in this respect, and as *Hylæ* are, as far as my experience extends, very constant in coloration, I suspect that the forms below described are true species.

The *H. punctariola* is distinguished by the posterior position of its vomerine teeth, the small tympanic membrane, and the free fingers. In all of the Costa Rican specimens the fingers are not entirely free, but a web extends between the outer two to the middle of the first phalange. The area of the tympanum in the same is one-fourth that of the orbit. The head is short and wide, and the heel extends nearly or quite to the end of the muzzle.

Subspecies *pictipes*: color light brown above, not sharply bordered on the sides, below white. Edge of upper lip, tarsus, and outer toe, white. The sides are marbled with dark-brown and yellow from near axilla to groin; and the front and back of the femora on each side of the superior brown longitudinal band are yellowish-brown, spotted with bright yellow. Two outer toes brown, inner toes yellow. Humerus, cubitus, and two outer fingers, brown above. Back, lips, and belly, unspotted. Two specimens.

Subspecies *moesta*. Above brownish-black, sides and femora, except above and below, deep black. Some white spots on sides behind axillæ, and some small yellow ones near groin. A few minute white points on front and back of femur, and upper surfaces of feet. Otherwise the limbs and hands, except the thumb, are black. Lower surfaces thickly black spotted except on breast and tibia, where the white predominates. One specimen.

Subspecies *monticola*. Color light grayish-brown with large dark-brown spots, forming transverse bars, one between the eyes, one in front of the scapulæ, one behind the scapulæ, and one at the sacrum. Below unspotted white. Limbs with light-brown surfaces above; concealed surfaces pale, unspotted. No inguinal spots; a few specks of brown on sides. Length of head and body .037 m. Size of *H. p. moesta* identical; of *H. p. pictipes* a little smaller. One specimen.

The original *H. punctariola* is from Veragua, Panama.

Before leaving the genus *Hyla*, I may mention that the *Hyla polytania*, Cope, (Proc. Amer. Philos. Soc. 1869, p. 164) has been described by Prof. Peters as *H. striata* (Monatsber. K. Preuss. Acad. 1872, p. 681).

20. *SMILISCA BAUDINII*, Dum. Bibr. (*Hyla*). *Smilisca*, Cope.

San José, Dr. Van Patten.

21. *AGALYCHNIS MORELETHI*, A. Dum. (*Hyla*). *Agalychnis*, Cope. *Hyla holochlora*, Salvin.

San José, Dr. Van Patten.

22. *PHYLLOBATES HYLÆFORMIS*, Cope, sp. nov.

A species of medium size, resembling a *Hyla* in its habit. The head is a broad oval, and the muzzle is not produced, but is depressed. Interorbital space wide, plane; canthus rostralis obtuse, straight, lores oblique. Tongue an elongate oval narrowed before, flat, and one-half free. Ostia pharyngea very minute; membranum tympani one-sixth of orbit. Fingers and toes free, dilatations rather large. Skin smooth above and below.

Color above rich brown, divided on the vertebral line by a narrow red stripe. Femora light brown before and behind. Gular region with large vocal sac, of a rose color. Abdomen and inferior surfaces of femur and tibia with a rosy or orange pigment.

	M.
Length of head and body . . . . .	.027
“ to orbit . . . . .	.003
“ to angle of jaws . . . . .	.009
Width between angle of jaws . . . . .	.010
“ orbits . . . . .	.003
Length fore limb . . . . .	.017
“ fore foot . . . . .	.006
“ hind limb . . . . .	.037
“ hind foot . . . . .	.018

From the mountain of Pico Blanco, at 7000 feet elevation.

23. *LIYLA GUENTHERII*, Kefenstein, Archiv für Naturgeschichte, 1868, p. 296.

Allied to the species of *Lithodytes*, and unknown to me.

24. *LITHODYTES PODICIFERUS*, Cope, sp. nov.

Allied to the *L. conspicillatus*. The head and body short, and the hinder limbs long. Canthus rostralis straight, end of muzzle truncate, not projecting beyond lip. Vomerine teeth in two short series entirely behind the internal nares, but directed forwards and outwards towards them. Outline of mouth an oval. Muzzle plane above, parietal region slightly concave. Membranum tympani two-thirds the size of the orbit. Ostia pharyngea a little larger than choanæ. Nostrils much nearer to each other than to the orbits. Skin smooth. The muzzle extends beyond

The shorter hind limbs and larger tympanic membrane, with the more transverse and widely separated vomerine teeth, distinguish this from the last species. Represented by one small specimen from the Pico Blanco.

29. *LITHODYTES HABENATUS*, Cope, sp. nov.

This species, also represented by one specimen, agrees with the *Lithodytes muricinus* in the points just enumerated in which it differs from the *L. podiciferus*. Its general color is blackish-brown above, and dirty-white below. On each side above, a white band extends from the orbit to the middle of the side, where it is continuous with the pale color of the abdomen. The vomerine teeth are in small fasciculi, well separated, and both behind and within the line of the nares.

	M.
Length of head and body . . . . .	.022
“ hind limb . . . . .	.037
“ hind foot . . . . .	.015

From the Pico Blanco.

30. *LITHODYTES MELANOSTICTUS*, Cope, sp. nov.

A species of distinct type from the preceding in its short head and longer body. Size of *Rana temporaria*. The vomerine teeth are in two short transverse series entirely behind the inner nares, well separated from each other and not extended outwards beyond the line of the inner margin of the nares. Choanæ and ostia pharyngea sub-equal; tongue sub-round, one-third free, and a little emarginate behind. Head flat, wide, muzzle projecting a little, canthus rostrales straight convergent. Nostrils more than twice as far from orbits as from end of muzzle; their distance apart 1.33 times in their distance from the orbit. Loreal region and lip oblique. Diameter of eye equal distance from its border to the nostril, its area four times that of the membranum tympani, which is a rather narrow vertical oval. Skin everywhere smooth. Limbs long, dilatations of fingers large, of toes moderate. The muzzle marks the middle of the cubitus and a little beyond the middle of the tibia. The order of lengths of the fingers is, 1-2-4-3; first and third toes equal. The sternum is a wide cartilaginous shield notched at the end. There is a well-developed zygomatic process of the squamosal bone, but no corresponding malar process.

	M.
Length of head and body . . . . .	.050
“ to angle of jaws (axial) . . . . .	.015
Width of head at angle of jaws . . . . .	.022
Length to orbit (oblique) . . . . .	.007

Length to axilla . . . . .	.019
Width of sacrum . . . . .	.009
Length of fore limb . . . . .	.037
“ of fore foot . . . . .	.019
“ of hind limb . . . . .	.096
“ of hind foot . . . . .	.045

Ground-color above, brownish-gray; below, dirty-white. The limbs are cross-banded rather distantly with blackish, the bars extending on the front and back faces of the femur as well as on the upper surfaces. A white median band from muzzle to vent, which is bounded on the sides at different points with blackish. A pink band extends from above each tympanum to the end of the ilium, and is broadly bordered with black on the outer side, this color extending on the sides of the animal as oblique black spots. The tympanum is black and sends a black bar to the rictus oris; two black bars pass directly from the orbit to the lip, and another by the canthus rostralis and nares to the same.

One specimen from 7000 feet elevation on the Pico Blanco.

31. LITHODYTES MEGACEPHALUS, Cope, sp. nov.

A large species with the physiognomy of a *Ceratophrys*. Head very large, wide, and depressed, with oblique lips and lores. The end of the muzzle descends obliquely from the nares to the lip. Orbit as long as the distance from its border to the nostril, which is close to the line of profile, and distant from its fellow two-thirds its distance from the orbit. Canthus rostralis distinct, not prominent, very little concave. Orbits oblique, the superciliary borders rising from the end of their anterior third into a strong ridge, which runs in a straight line and terminates abruptly in a slight thickening at the posterior border of the cranium. The posterior half of the cranium above is thus deeply grooved, while the top of the muzzle is plane. The tympanic membrane is a vertical oval equalling one-third the area of the opened eye; its long diameter enters the latter 1.75 times; its short diameter, three times. The vomerine teeth are in two short approximated series entirely behind the posterior borders of the choanæ. Each is convex forwards, and does not extend exterior to the line of the inner boundary of the choanæ. The tongue is oval, longer than wide, and widest behind where it is entire. Ostia pharyngea larger than choanæ. The limbs are short, and the fingers and toes entirely free. The dilatations are small, especially on the hands, but the terminal phalanges are T-shaped. The wrist extends beyond the end of the muzzle, while the heel only reaches to the middle of the orbit. There is a

small but prominent obtuse cuneiform bone at the base of the inner toe; other than this there are no folds or tubercles on the tarsus or carpus.

The skin is smooth on the upper and lower surfaces, with the following exceptions: A dermal fold extends from each exoccipital region on each side of the back, pursuing a concave course to the middle of the transverse process of the sacrum. A similar fold extends from the vent on each side, in an oblique direction to the end of the transverse sacral process. Sides of body areolated.

The exoccipital bone sends inwards and backwards a recurved crest, in anticipation, as it were, of the "parieto-quadrate" arch of *Ceratophrys*. There is also a strong zygomatic process of the squamosal, but no malar process to meet it.

The color above, in spirits, is a light ash; below white, the sides of an intermediate shade. A black spot extends from the tympanum to the scapula, and sends a line to the eye. The posterior face of the femur is black marbled distally with ash; the black extends as a well-defined patch to the vent. Entire sole of foot black. Legs distantly cross-banded above. Lips brown; some small dark spots on the lower rim of the orbit. The breast, abdomen, and lower side of femur and tibia are marked with black, forming a figure like the refuse of the plates of a button-maker, *i. e.*, representing the interstices between large confluent white spots.

	M.
Length of head and body . . . . .	.070
" to orbit (oblique) . . . . .	.011
" to angle of jaws (axial) . . . . .	.025
Width at angle of jaws . . . . .	.035
" of interorbital region . . . . .	.007
" of sacrum . . . . .	.017
Length of fore limb . . . . .	.038
" of fore foot . . . . .	.016
" of hind limb . . . . .	.092
" of hind foot . . . . .	.045

This species is intermediate between the *Ceratophrydine* group of *Cystignathidæ* and the *Hylodine*, and illustrates the propriety of their union as I proposed in 1865. I find no technical characters by which to separate it from *Lithodytes*, in which genus it is analogous to the *Hylodes sulcatus* in the genus *Hylodes*, where the same elevation of the superciliary borders appears. With present experience in the genus *Bufo*, such a character does not appear to warrant generic separation.

A female specimen, containing eggs ready for deposit, was taken by Mr. Gabb on a spur of the Pico Blanco, at 6000 feet elevation.

32. *LITHODYTES GULOSUS*, Cope, sp. nov.

The description of the *L. megacephalus* applies in many details to the present frog. Thus, the vomerine teeth, tongue, tympanum, cranial crests, and extremities are the same. The differences are seen in the absence of dermal plicæ, the coloration, and perhaps in the larger size. The color is a dark leather brown, except on the pectoral and abdominal regions and inferior surfaces of the femur and tibia, where the brown is irregularly marbled with white. There is a black spot across the tympanum and one under the eye.

The type specimen is a female containing mature eggs, and is twice as large as the type of the *L. megacephalus*, equalling the *Gnathophysa ocellata* in bulk. Its head is relatively smaller than in that species. Thus the width enters the length of head and body in the former, more than twice; in the latter, less than twice; the length of the head enters the same in the *L. gulosus* three times; in the *L. megacephalus* 2.66 times.

	M.
Length head and body . . . . .	.103
“ head to orbit (oblique) . . . . .	.015
“ head to angle jaws . . . . .	.030
Width head at angle jaws . . . . .	.047
“ head between orbits . . . . .	.008
Length fore limb . . . . .	.060
“ fore foot . . . . .	.022
“ hind limb . . . . .	.138
“ hind foot . . . . .	.065

The sternum of this species is a large cartilaginous plate, wide and deeply emarginate behind, and slightly narrowed in front. From the same locality as the last species.

33. *HYLODES CERASINUS*, Cope, sp. nov.

A slender species with oval head, and large digital dilatations. The vomerine teeth are in two fasciculi well separated from each other, and well behind the line of the internal nares, at the extremities of two longitudinal ridges, which diverge slightly forward towards the inner margin of the choanæ. The latter are about the size of the ostia pharyngea. The tongue is of a narrow oval form. The head is flat and the lores oblique. The muzzle is not produced beyond the lip, but is narrowed towards the end, the canthus rostralis being concave. The nostrils are twice as far from the orbit as from each other. Orbit large, tympanic membrane distinct, very small, one-eighth the area of the eye. The skin is smooth above in

the specimen, which is soft through the effect of weak spirits; skin of sides and abdomen areolate. Limbs rather long, digits long, free. The wrist and heel of the extended limbs reach the end of the muzzle. The lengths of the fingers are in order, commencing with the shortest, 1-2-4-3. Dilatations truncate.

	M.
Length of head and body . . . . .	.035
“ to orbit (oblique) . . . . .	.006
“ to angle jaws . . . . .	.013
Width to angle jaws . . . . .	.013
“ between orbits . . . . .	.0032
Length of fore limb . . . . .	.022
“ of fore foot . . . . .	.009
“ of hind limb . . . . .	.055
“ of hind foot . . . . .	.024

The sternum of this species is a parallelogrammic cartilaginous plate, deeply notched distally and not distinguished into style and disk.

General color brown above, white below. A rose-colored vertebral band. Four pale lines from orbit and one from nostril cross the upper lip. Anterior half of sides finely reticulate with black, groin cherry-red. Upper posterior face of femur and inner face of tibia cherry-red; lower posterior face of femur brown punctate with white.

This beautiful species is apparently related to the *H. bicumulus*, Peters, from Venezuela, but differs in several points. In *H. cerasinus* the nares are terminal, many times nearer the end of the muzzle than to the orbit; in *H. bicumulus* less than twice as far from orbit as from snout. The tympanic disk is smaller in the *H. cerasinus*, and the coloration entirely different. These comparisons are rendered possible by the fulness of Prof. Peters's description, and it is a gratification to refer to them as models worthy of imitation in all departments of biology.

One specimen from the eastern slope of the Pico Blanco.

34. GNATHOPHYSA OCELLATA, Linn. (*Rana*); *Cystignathus*, Dum., Bibr.; *Gnathophysa*, Cope.

From the east side of the Cordillera.

RANIFORMIA.

35. *TRYPHEROPSIS CHRYSOPRASINUS*, Cope, Proc. Acad. Philada., 1868, p. 117. *Ranula*, do., Cope, l. c. 1866, p. 130.

From Uren, 2500 feet.

In examining a collection sent to the Smithsonian Institution from Costa Rica, from Charles N. Riotte, I was much surprised to notice what was apparently a *Hylorana* near *H. erythræa*. Doubting the correctness of the locality, I laid the frog away. Having since seen other and allied species from Tropical America, I recognize the existence of a genus representing *Hylorana*, but differing in the important particular of the incompleteness of the ethmoid arch, its superior plate being represented by cartilage. In the present species the terminal phalanges are slender, and furnished with a transverse limb, though the dilatations are small; the latter are distinct in the *Rana cæruleopunctata*, Steindachner; in an undescribed species from Vera Paz the transverse limb is very small, but present.

The generic characters then are—

Ethmoid arch superiorly cartilaginous; prefrontals narrow, longitudinal, widely separated. Distal phalanges slender, with transverse limb; no metatarsal shovel; tongue bifurcate.

The species is allied to the above named, but has a relatively shorter muzzle and limbs. Nostril nearer end of muzzle than orbit (equidistant in *cæruleopunctata*); muzzle 1 and 1-5th orbit (1 and 2-5ths Steind.). Under jaw anteriorly abruptly truncate. Canthus rostralis straight, strong, muzzle acuminate from its extremity, projecting; loreal region vertical. Tympanum elliptic, two-thirds orbit. Vomerine teeth weak, in convergent fasciculi behind opposite nares. Skin shagreened above, a glandular fold on each side. The longest finger cannot be extended to vent; heel to middle loreal region. Toes fully and widely palmate, three distal phalanges of fourth free; one minute metatarsal tubercle.

Color brilliant leek-green, the groin and belly approaching golden; a golden band from lip to shoulder, and a faint one on each side of back. Limbs above, and tarsus and forearm below, black, the femur with a few golden spots on black ground behind. Head dark above, from eye to shoulder black; below pale yellowish-green, immaculate, except some dark shades on sternal regions.

Length of head and body 1 in. 9 l.; of fore limb 1 in.; of hind limb 2 in. 7.5 l.

36. *RANULA BREVIPALMATA*, Cope, loc. cit. 1874, p. 131.

The upper lip and lower surfaces brown spotted. From Pico Blanco.

REPTILIA LACERTILIA.

LEPTOGLOSSA.*

37. *MOCOA ASSATA*, Cope, Proceed. Acad. Phila. 1864, p. 179.

From Old Harbor; originally described from the west coast of Salvador.

38. *MABUIA ALLIACEA*, sp. nov.

Distinguished by its long acute muzzle, and reduced number of rows of scales. The former exceeds the width of the head between the eyebrows, and is narrow at the end. There are seven superior labial scuta, of which the fifth subtends the orbit, and is very elongate. The internasals are very narrow and are separated above by a small median scutum in front of the internasal. This scale may be abnormally distinct. Interfrontonasal wider than long, in contact with frontal; latter long, narrowed behind, its apex received into a notch between the frontoparietals.

* *EPAPHELUS SUMICHRASTII*, Cope, gen. et sp. nov.

Char. Gen.—A scincoid allied to *Gymnophthalmus*, without eyelids. Toes 4–5. Nostril in a single plate; no supranasals; one loral. Frontonasals distinct. One large supraocular, and one large supraorbital; frontoparietals and interparietal confluent; parietals distinct. Scales large, smooth, and subequal. Meatus auditorius open.

This genus is characterized by the greater simplicity of the cephalic scuta than any of the genera of this group with toes 4–5.

Char. Specif.—Twelve rows of scales on the body. Labial scuta $\frac{4}{4}$, the last inferior very narrow. Behind the symphyseal is a very large mental, which is a little wider than long, and behind it two pairs of large transverse infralabials meet on the middle line. The frontal is very small, scarcely one-fourth the size of the supraorbital, which is a little larger than the interfrontonasal, and much less than the interparietal. Behind each parietal are two transverse scales, each pair separated on the median line by a scale like those of the back. Three scales margin the vent, of which the median is the least. The extremities appressed to the sides fail to meet by the length of the hand.

Color light rose-color, metallic on the upper surfaces, the tail bright pink, the top of the head bluish. Sides of head and body to groin deep brown, the color abruptly defined above; below unspotted.

	M.
Total length . . . . .	.0450
Length to vent . . . . .	.0205
“ to axilla . . . . .	.0090
“ to ear . . . . .	.0038
“ of fore leg . . . . .	.0040
“ of hind leg . . . . .	.0065
“ of hind foot . . . . .	.0037

Since the above description was written I have obtained a specimen of identical proportions, but of twice the size. It was obtained by Dr. Francis Sumichrast in the western part of the State of Tehuantepec, and is of interest as the first naked-eyed scinc discovered in Mexico. It is dedicated to its discoverer, who has added so largely to our knowledge of that country.

Four supraorbitals, second large. Interparietal longer than wide, separating the wide, undivided parietals. Two transverse narrow occipitals. Nuchal scales equal those of the body, which are in twenty-seven rows. Preanal scales three, large and subequal; subcaudal scales small except where reproduced, when they are transverse and narrow. When the limbs are appressed to the sides the ends of the toes mark the middles of the fingers.

Color above, sap-green shaded with brown, below leek-green. A light blue band from the lip to the groin; a pale shade from the eyebrow to above the femur, brown bordered above. From the low country.

The large preanal scuta and long muzzle distinguish this species from the *M. cepedei*.

39. *MABUIA CEPEDI*, Gray; Cope, Proceedings Academy Phila., 1862, p. 186.

With twenty-eight rows of scales. From below Sipurio.

40. *CHALCIDOLEPIS METALLICUS*, Cope; gen. et spec. nov. *Ecpleopidarum*.

Char. Gen.—Dorsal scales smooth, in uninterrupted transverse annuli round the body, the size subequal on the various regions, including the nuchal and gular. Toes 5-5, all clawed. Superior head shields; interfrontonasal, two prefrontals, a frontal, two frontoparietals, two parietals separated by an interparietal. Tympanum distinct; nostril in the single nasal plate. No femoral pores. Teeth compressed, with a principal cusp and a denticle on each side.

This genus is one of the *Ecpleopidæ*, but presents a manifest resemblance to the *Chalcididæ* in its squamation. The absence of the lateral band of small scales, and continuity of the transverse series across the median line of the back, distinguish it from certain genera of the family, and the uniform character of the squamation of the neck and body distinguishes it from others.

Char. Specif.—A slender lizard with very long tail and feeble limbs. The head is narrowed and acute in front, with produced rostral shield. The interfrontonasal plate is as wide as long, and the frontal elongate. There are four supraorbitals on each side. The interparietal is elongate and with parallel sutures with the larger parietals. The latter are bounded externally by a large temporal, forming with them a diagonal suture. These are all bounded posteriorly by a series of four shields across the occiput, and these again by a transverse series of seven scales larger than those of the nape which follow them. The nasal plate is followed by a large loreal, and this by a smaller preocular. Seven superior labials; their relative lengths, beginning with the shortest, are, 5-7-6-2-1-3-4. Two pairs of infra-labial scuta are in contact on the median gular region, of which the posterior pair

are twice as long as the first; there are twenty scales in a cross-row between the angles of the lower jaw. There is some irregularity in the pectoral scales which gives the last row of the neck the appearance of a collar. Twenty-three series of scales in an annulus of the body; twelve transverse rows between the large post-occipital row and the line of the axillæ, and forty-three to the line of the posterior faces of the femora. There are two large longitudinal anal scuta, which embrace a scale between them on the anal border; they are preceded by another large pair, but of reduced size.

The tail is nearly twice the length of the head and body, and the hind limb is one-fourth the latter measurement.

	M.
Total length	0.165
Length of head and body . . . . .	.058
“ to axilla . . . . .	.017
“ of head to tympanum . . . . .	.011
“ “ to orbit . . . . .	.0045
“ of fore limb . . . . .	.0130
“ of hind limb . . . . .	.0145

The limbs are surrounded by large scales except on the concealed faces of the humerus and femur, where the scales are small and flat.

The color is light gray with red and green metallic reflections; the sides are brown, and the middle of the back darker than a line above the brown of the side. Near the light bands a few scales are blackish, forming a row on each side. Below dusted with brown. Head with deep brown sides and white upper lip. Sides of tail brown with a zigzag upper margin.

The lower eyelids of this species are very narrow, and having been dried I cannot ascertain the presence or absence of a transparent disk.

This new lizard was found by Mr. Gabb on the Aguacate Mountains.

41. *AMIVA FESTIVA*, Licht. and Von M. *A. eutropia*, Cope, Proc. Ac. Phila., Feb. 1862.

In adult males the dorsal band is wanting. The central preanal plate is frequently followed by two scuta but little smaller.

42. *AMIVA GABBIANA*, Cope, sp. nov.

Abdominal scuta in eight longitudinal series, median gular scuta but little larger than those surrounding them. Premaxillary teeth 4-1-4. Mesoptychial scales in a single row of one median and three rapidly diminishing laterals on each side; the border of the collar with minute scales. One row of brachial scuta nearly continuous with two rows of antebrachials. One principal row of rather

small postbrachials. Anal scuta; one large round submedian disk, and two or three much smaller in advance of it. Two rows of large tibial scuta, with a few odd scuta on the inner side. No anal nor heel spurs. Nostril on the naso-inter-nasal suture. Frontal scute rather short, undivided; parietals and interparietals short, followed by a few scales larger than the granular ones which cover the back and the nape. The hind limb extended reaches the front of the tympanum by the end of the longest toe; the fore limb extends to just beyond the end of the muzzle.

	M.
Total length . . . . .	.215
Length to vent . . . . .	.082
“ to axilla . . . . .	.035
“ to tympanum . . . . .	.017
“ to orbit . . . . .	.008
Width of head at angle of jaws . . . . .	.013
Length of hind limb . . . . .	.056
“ of hind foot . . . . .	.030

Color olivaceous; two lateral light bands separated by a darker shade than that of the dorsal interval, and crossed, like the side below the lower line, by black bars. Below immaculate, or with black spots on the gular region.

Three specimens of this species were obtained at Old Harbor by Mr. Gabb, to whom I dedicate it. Its affinities are with the *A. guttata*, Wieg.

DIPLOGLOSSA.

43. DIPLOGLOSSUS MONOTROPIS, Kuhl.

44. GERRHONOTUS FULVUS, Bocourt, Bulletin Archives du Museum, 1872, p. 104.

Agrees with the description of Bocourt excepting in having the prefrontal plates distinct, and in having a narrow dark band on each side of the back.

From the summit of the Pico Blanco.

NYCTISAURA.

45. COLEONYX ELEGANS, Gray, Ann. Mag. Nat. Hist., 1845, p. 162; Dumeril, *Gymnodactylus coleonyx*, Archives du Museum, 1856, p. 483; *Brachydactylus mitratus*, Peters, Monatsber. K. Preuss. Akad., 1863, p. 42.

Costa Rica, fide Peters.

46. PHYLLODACTYLUS, indet.

47. SPHÆRODACTYLUS GLAUCUS, Cope, Proceed. Acad. Philada., 1865, p. 192.

Variety with dark bordered interscapular and sacral transverse spots. Near Sipurio.

48. *THECADACTYLUS RAPICAUDUS*, Houtt.

Mouth of Estrella or North River, E. coast.

IGUANIA.

49. *ANOLIS MICROTUS*, Cope, Proceedings Academy Philadelphia, 1871, p. 214.

Auricular opening not larger than nares. Scales generally larger than in *A. insignis*; four rows between orbits, two rows of large ones above orbits; seven rows between rows of canthus rostralis at middle of muzzle, three loreal rows at middle; three large smooth infralabial rows. Scales of tail and fore leg three or four keeled.

Brown with cross-bands of large paler ocelli crossing the sides behind the axilla, at middle, and at crura. Eye and a broad band to shoulder, dark brown.

Description.—Scales of back, sides, and belly equal and smooth. Tail compressed at base, distally cylindric, covered with equal scales. Front without ridges but with well-marked concavity; all the scales covering it equal and smooth. Occipital or parietal region concave, with high lateral posterior bounding ridges, which do not unite, but leave a notch between them (in one specimen). Occipital region covered with small scales. Zygomatic arch prominent, canthus rostralis not tubercular. Face well developed. First two infralabial scales larger than the others. Limbs short, stout; anterior not reaching groin; posterior extending to angle of lower jaw. Dilatations well developed.

	M.
Total length	0.31
Length to orbit . . . . .	.015
“ to ear . . . . .	.03
“ to axilla . . . . .	.05
“ to groin . . . . .	.0955
“ to convergence of parietal crests . . . . .	.029
“ of fore foot . . . . .	.017
“ of tibia . . . . .	.0183
“ of hind foot . . . . .	.027
Width at anterior angle of orbits . . . . .	.0125
“ at zygomatic arch . . . . .	.017

This species is darker than the next, and is much less ornamented. The color is a rich yellowish-brown; where the epidermis is lost on the head a strong yellow pigment appears, so that it is probable that it could in life change to that color at will. A deep brown band commences by covering the whole eye and extends to

the shoulder, where it is marked by pale centred ocelli. It is separated above by a narrow paler band from a large dark brown patch that covers the nape and scapular regions. Limbs and tail broadly and indistinctly brown cross-banded. Belly and throat immaculate.

San José, Costa Rica; Dr. Van Patten.

This large species is allied to the next, but perhaps resembles more the *Anolis biporcatus*, Wiegman, the largest *Anolis* of Mexico. The latter has, among other points of difference, keeled abdominal scales and a shorter muzzle, with very different coloration. The uniform size of all the scales is a noteworthy character of the *A. microtus*.

50. *ANOLIS INSIGNIS*, Cope, Proceed. Academy Philadelphia, 1871, p. 213.

Auricular opening half as large as eye. Scales intermediate; seven rows between orbits; one or two supraorbital rows but little larger than the others; eight rows across middle of muzzle, and six across loreal region at middle. Three large and two small keeled infralabial rows. Scales of arm smooth, of tail striate.

Fawn-brown, with four double bands of greenish-blue between axilla and tail. Between these the brown is divided by a yellow band which widens below and breaks into spots above. A large round greenish-blue spot with brown centre in front of axilla.

Interorbital and occipital regions deeply concave, the latter bounded posteriorly by two elevated osseous ridges which meet behind at an acute angle. No facial rugæ, front flat except a slight median elevation. Muzzle with broad median ridge. Scales of front equal, those of canthus osseous. Postfrontal and zygomatic arches prominent, rugose. Inferior loreal row of scales larger than others, nares surrounded by small scales. Fan very largely developed. An elevated crest or dermal fold on the nape. Scales of the sides and back (except some median rows) flat, pavement-like, equal, smooth, one-third the size of the smooth ventrals. Four median dorsal rows subconic, smaller than the ventrals. Tail proximally compressed, covered with equal scales. Limbs stout, the anterior extending four-fifths way to groin; the hinder reaching nearly to the ear. Scales of the limbs small; dilatations distinct.

The colors of this *Anolis* are very elegant. Besides the large spot behind the angle of the mandible, there is a blue one on the angle surrounded by fawn-color, and this by yellow. Sides of the temporal region and neck with yellow spots. Bluish of first cross-band in a coarse netted figure. Top of head fawn-color; face entirely vermilion; belly light yellow. Tail with broad blackish annuli; limbs with dark cross-bars, three on tibia, femur, and forearm; two on humerus.

	M.
Total length	0.440
Length to orbit . . . . .	.0183
“ to ear . . . . .	.037
“ to axilla . . . . .	.062
“ to groin . . . . .	.135
“ to angle of parietal crests . . . . .	.035
Width at anterior angle orbits . . . . .	.014
“ at zygomatic arches . . . . .	.019
Length of fore foot . . . . .	.023
“ of tibia . . . . .	.029
“ of hind foot . . . . .	.040

From San José. Dr. Van Patten.

This is a large species, being about equal to the *A. edwardsii* of Jamaica. It is one of the most elegantly colored among the species of a beautiful genus. Its affinities, as already pointed out, are to the *A. squamulatus*, Peters, which is very near the *A. laticeps* of Berthold.

51. *ANOLIS COPEI*, Bocourt, Mission Scientifique de Mexique, Reptiles, p. 77, Pl. xv., f. 10, 10 a.

Three specimens from Old Harbor. Color in life blue and brown. This animal haunts sunny spots on the edge of the forest.

52. *ANOLIS TROCHILUS*, Cope, Proceed. Acad. Philadelphia, 1871, 215.

Specimens from Talamanca and San José.

Abdominal scales small, flat, smooth; tail cylindric, with similar scales. Dorsal scales smaller than ventral, pavement-like, very weakly keeled, graduating into those of the lower part of the side, which are smaller. Head moderately elongate; width between anterior margins of orbit equal length of muzzle from same point, measured on the side. Interrugal concavity of the front well marked, occupied by very small scales, much less than those of the rugæ, in nine rows. Scales between rugæ and canthus large. Two rows separate the superciliaries, which are separated by three or four rows from the occipital. Five rows of loreal scales. Six smooth scales in the supraorbital disc, three inner large, transverse, the three outer longitudinal. Four rows of infralabials medially; nostril surrounded by small scales. Auricular meatus one-half eye-slit.

Limbs long, toes slender, the dilatations well marked. The fore limb appressed reaches the groin; the hind limb extended attains the end of the muzzle. Fan little developed.

Above and below brilliant metallic green, with a few black dots along the vertebral line. Head and anterior part of sides, brown; a black V extending from the auricular openings, which are connected by a broad black band with the orbits. Another V extends towards the occiput from the limbs of the nuchal V, enclosing a narrow brown area with it. Top of muzzle and limbs blackish.

	M.
Total length	0.108
Length to orbit . . . . .	.005
“ to ear . . . . .	.011
“ to axilla . . . . .	.018
“ to groin . . . . .	.0378
Width of head behind . . . . .	.006
Length of hind foot . . . . .	.014

San José. Dr. Van Patten.

This small species is very abundant in Costa Rica, and is found also in Nicaragua.

53. *ANOLIS PACHYPUS*, Cope, sp. nov.

Tail slender, cylindric, with equal scales, swollen at the base. Scales of the abdomen smooth, those of the sides very small, on the back gradually enlarging to two or three largest and faintly keeled rows on the median line, which are much smaller than those of the belly. The head is rather short, its length equalling that of the tibia, and one-half greater than its width. Scales of top of head subequal in front, keeled; smaller and angular behind, covering a three-sided area behind the orbits, which is abruptly distinguished from the minute granules of the temples and nape. No facial rugæ distinct from canthus rostrales, but the frontal region concave from between the orbits to the middle of the muzzle. Superciliaries not larger than the scales of the five rows which separate them; frontal concavity with similar scales, and a little smaller than those of the three rows which separate them from the canthal row. Latter consisting of six scales, and continued on the edge of the eyebrow to near its middle in a manner unusual in the *Anolidæ*. Supraorbital region covered with projecting granules, except a single row of three or four small keeled supraoculars near the supraorbital border. Four rows between supraorbital series and occipital scale; eight loreal rows. Only one series of very small infralabials, the gulars running up to them in longitudinal lines. Meatus auditorius larger than occipital scale.

The feet are stout and clumsy; the wrist reaches the front of the orbit, and the end of the third toe of the hinder foot, the end of the muzzle. The digital dilata-

tions are little or not more expanded distally than proximally, and the distal joints are covered with wide keeled scales above. Fan well developed.

Total length	.	.	.	.	.	.	.	.	.	M.
										.135
Length to vent	.	.	.	.	.	.	.	.	.	.047
“ to axilla	.	.	.	.	.	.	.	.	.	.020
“ to tympanum	.	.	.	.	.	.	.	.	.	.011
“ of fore limb	.	.	.	.	.	.	.	.	.	.022
“ of fore foot	.	.	.	.	.	.	.	.	.	.009
“ of hind limb	.	.	.	.	.	.	.	.	.	.043
“ of hind foot	.	.	.	.	.	.	.	.	.	.019
“ of tibia	.	.	.	.	.	.	.	.	.	.012

Color emerald-green, with a broad brown band from the orbit to the middle of the side, and a narrower one on each side of the sacrum. A green band from orbit to below tympanum, and a dark-brown band from orbit below the canthus rostralis. A dark-brown cross-band between the superciliary borders across the front. A deep brown spot behind the occiput, and a smaller one on the nape. Femur with a longitudinal black band behind, and an oblique one across the superior face. Tibia and forearm with a broad cross-band.

From the slope of the Pico Blanco; elevation not known.

A species markedly distinct in many respects, approaching the *A. scyphaeus* in its few small supraocular scales.

54. *ANOLIS OXYLOPHUS*, Cope, spec. nov.

A species above medium size of the group with keeled ventral scales and without caudal crest or serra. The dorsal scales are distinctly larger than the lateral and about equal to the ventral. They are flat, subhexagonal, not imbricate, and have a median keel. There are at least twenty rows of equal size, those exterior to them graduating in size to the laterals. The scales of the upper surface of the head are very small, but flat, seven rows separating the rugal, and two the superciliary scuta. Small scales separate the rugal and canthal scuta. Occipital scute of moderate size, bounded laterally and in front by a number of scuta of the same size and form. Supraorbital disk composed of two rows of slightly keeled scuta with some small ones adjacent. Ten rows of loreals; 13-12 labials. Infralabials all very small and carinate. The canthus rostralis is distinct to near nostril. The facial ruga is remarkably prominent and acute, but not extending beyond the middle of the canthus. Auricular opening about one-fourth as long as the eye diameter. The form of the head is regular, and of good proportions; it is as long

as the tibia. The middle of the third finger reaches the end of the nose, while the end of the longest toe reaches the middle of the orbit.

The color is a dark brown, the limbs and feet with pale cross-bands. A distinct whitish band extends from the scapular region to near the groin. Abdomen yellowish, with a broad brown border on each side. The fan is very large, but the color is altered by the alcohol.

	M.
Total length . . . . .	.217
Length to vent . . . . .	.076
“ to groin . . . . .	.071
“ to axilla . . . . .	.035
“ to ear . . . . .	.019
“ to orbit . . . . .	.008
Width of head at angle of jaws . . . . .	.011
Length of hind limb . . . . .	.060
“ of hind foot . . . . .	.025

Both ♂ and ♀ specimens, the latter considerably smaller.

This species is allied to *A. paecilopus*, Cope, and *A. concolor*, Cope (Proceed. Academy Phila., 1862, pp. 179–80). From the former it differs in the much more prominent frontal rugæ, the larger facial and especially posterior cephalic scales, and in the shorter hind legs. The latter differs in its obtuse ridges, larger facial and loreal scales, fewer labials, and other points.

55. *ANOLIS INTERMEDIUS*, Peters, Monatsber. K. Preuss. Acad. 1863, p. 143.

One specimen.

56. *ANOLIS CAPITO*, Peters, Monatsber. K. Preuss. Acad. Wiss. 1863, p. 142.

Five specimens from Old Harbor.

57. *ANOLIS TESSELLATUS*, O'Shaughnessy, Annals and Magaz. Nat. History, 1875, p. 279.

“Costa Rica.”

58. *POLYCHRUS MULTICARINATUS*, Peters, Monatsberichte K. Preuss. Akad. 1869, p. 786. Bocourt, Miss. Sci. Mexique, Pl. XVII. fig. 8.

Unknown to me.

59. *CORYTHOPHANES CRISTATUS*, Merrem. Dum. Bibr. IV. p. 174.

Sipurio.

60. *IGUANA RHINOLOPHA*, Wiegmann, Herp. Mexicana, 44.

From the low country; Dr. Gabb.

61. *CYCLURA ACANTHURA*, Wiegmann, Herpetologia Mexicana, 42, t. 2.

San José; Dr. Van Patten.

62. *BASILISCUS VITTATUS*, Wieg. *Herpetologia Mexicana*, p. 40, Pl. 15, 1834. *Corythæolus vittatus*, Kaup, Wiegmann. *Basiliscus*, Duméril. *Basiliscus nuchalis*, Cope, *Proceed. Academy Philada.*, 1862, p. 181, (Southern form.)

Drs. Wiegmann, Wagler, Kaup, and Gray have described only the female of this species, and have established the genus *Corythophanes* on characters which belong to the female sex only. Prof. Duméril finds the male to possess the essential features of the genus *Basiliscus*, and I follow him in referring the species to that genus, as the specimens of the Smithsonian collection abundantly demonstrate the correctness of the view of the French herpetologist. The specimens from Nicaragua and Costa Rica differ from those of the north in their smaller size and larger dermal appendages. This variety I named *B. nuchalis*. The species ranges north to Vera Cruz.

Abundant. Numerous specimens from Sipurio. Mr. Gabb, like Dr. Sumichrast, states that this species runs over the surface of the water whose shores it frequents, like a spider.

The species of the genus *Basiliscus* known to me differ as follows:—

I. Dorsal and caudal rayed crests present.

Two dermal head-crests, the anterior narrow; both with large scales; four rows of interorbital scales; yellow spots; no longitudinal bands. *B. plumifrons*.

One dermal head crest, with large scales; one row of interorbital scales; no longitudinal bands. *B. mitratus*.

One expanded head crest with small scales; one row of interorbital scales; no longitudinal bands. *B. guttulatus*.

One tassel-like head crest with small scales; more than one interorbital row; no longitudinal bands. *B. goodridgii*.

II. A dorsal, no caudal rayed crest.

A single membranous head-crest covered with large scales; two or three interorbital rows; one or two longitudinal light bands on each side. *B. vittatus*.

III. Neither dorsal nor caudal rayed crests.

A membranous head-crest of a horizontally elliptic form, covered with large scales; uniform green. *B. seemanni*.

63. *BASILISCUS PLUMIFRONS*, sp. nov.

Represented in Mr. Gabb's collection by five male and one female specimens in fine preservation. It is more nearly allied to the *B. mitratus*, Daud., than to the *B. goodridgii* and *B. seemanni* of Gray, or the *B. vittatus*, Wiegmann. The abdominal scales are smooth, and both back and tail support elevated crests traversed by osseous rays. The head crest consists of a principal posterior portion

and an accessory anterior portion. The former commences above a point a little in front of the anterior margin of the meatus auditorius, and extends upwards and backwards to a subacute termination. The posterior border descends in an open sigmoid to the nape of the neck to a point a little behind the angle of the jaws. It is covered with large thin smooth scales, and its borders are acute. The anterior part of the helmet rises abruptly from a point in line with the posterior border of the orbit, its anterior border sloping backward to the obtuse extremity, which marks the basal third of the principal helmet. It is separated to the base from the latter by a fissure. The top of the head is covered with small scales, which are weakly or not at all keeled. The supraorbitals are smaller than the supraocular row, and weakly keeled; those covering the occipital protuberance are equal to them and nearly smooth. Three or four rows separate the superciliary series. Two distinct plates precede the nasal plate, the anterior in contact with the corresponding one of the opposite side. Labials, counting to the posterior border of the eye, seven above and seven below. The anterior three infralabials in contact with the inferior labials. Loreal rows four.

The dorsal scales are smaller than the ventral, but little larger than the lateral, and faintly keeled. Those of the upper surfaces of the limbs are as large as the abdominal and strongly keeled. The dorsal crest is highest behind the middle; its elevation exceeds that of the body by one-third; it is supported by fifteen rays. The scales covering it are smooth. The caudal crest is also elevated, and includes fifteen rays; it is covered by thin subequal scales, of which there are eight in a vertical row. Scales of the tail strongly keeled below, weakly keeled elsewhere. The fore foot is rather short; the ends of the metacarpals mark the muzzle when the limb is extended; the same point is reached by the ends of the basal phalanges of the extended hind limb.

Color everywhere green, becoming blue on the different crests. No longitudinal or transverse bands on the head, body, or throat. A row of distant round yellow spots from the axilla to the groin, and a similar row along the upper side of the back, which is wanting in some specimens. Various scales of the helmet and crests are paler than the others. Three vertical pale-bordered black spots on the dorsal crest, which may be obsolete in some individuals. Crested part of the tail green, the remainder yellowish, with brown rings to the end of the proximal two-thirds.

	M.
Total length (25.75 inches) . . . . .	.655
Length to vent . . . . .	.177
“ to axilla . . . . .	.090

	M.
Length to ear . . . . .	.045
“ to orbit . . . . .	.016
“ of helmet . . . . .	.060
“ of dorsal crest (vertical) ; . . . . .	.045
Width between eyebrows . . . . .	.021
Length of fore limb . . . . .	.087
“ of fore foot . . . . .	.040
“ of hind limb . . . . .	.175
“ of hind foot . . . . .	.082
“ of tibia . . . . .	.057

Four of the specimens were taken at Sipurio.

Having had, through the attention of Professor A. Auguste Duméril, the opportunity of consulting the types preserved in the museum of the Jardin des Plantes, Paris, I can compare the present species with the original specimen of Seba, the type of the *B. mitratus* of Daudin. In that species, the anterior plume-shaped process of the front is wanting, and the helmet has a more posterior position. There is but one row of scales separating the superciliaries. There are five blackish transverse spots at the base of the dorsal crest, and two longitudinal pale stripes on the head and neck. These characters are borne out by two specimens procured by the expedition under Lieut. Michler from the Isthmus of Darien,* which offer other peculiarities also. Thus the caudal crest is chiefly covered by three longitudinal rows of large scales, there being but two or three of small ones below them. M. Bocourt (Miss. Sci. de Mexique, p. 127) states that the rays of the dorsal crest of the *B. mitratus* are 17–8, and of the caudal, 23; in the *B. plumifrons* they are constantly 15–15. The name of the species refers to the plume-shaped process in front of the helmet, which is constantly present. In the female the crests are wanting, and the helmet is very small, posterior, and without plume.

Mr. Gabb states that this species, like the other *Basilisci*, haunts the shores of rivers, where it lies on the bases of the leaves of the large canes which fringe the water. Its green color protects it from observation in this position, and it remains motionless when approached, so as to be readily caught by a noose of thread or hair.

64. SCELOPORUS MALACHITICUS, Cope, Proceed. Academy Philada., 1864, p. 178.

San Jose; Dr. Van Patten, C. N. Riotte.

* Vid. Proceed. Academy Philada., 1862, p. 356.

OPHIDIA.

SCOLECOPHIDIA.

65. *HELMINTHOPHIS FRONTALIS*, Peters, Monatsb. K. Preuss. Ak. 1861, p. 517.

Unknown to me.

Although no *Stenostomidæ* have yet been brought from Costa Rica, to my knowledge, yet they doubtless exist there, as the *Stenostoma albifrons* has been sent to the Smithsonian Institution from Panama by C. B. Adams, and a second species of the genus has been obtained in the western part of Tehuantepec by Dr. Francis Sumichrast. This appears to me to be new to science, and may be described as follows: I first compare it with those species of the genus which have but two labial plates, and no production nor angulation of the rostral plate, and in which the superciliaries are in contact with the first scale of the middle series, which is of the same form as those of the body. This species belongs also to those with large transverse temporal scales, and a narrow superciliary.

α . Superciliary in contact with first labial.

Last labial reaching one of the two temporals.

S. albifrons.

$\alpha\alpha$. Superciliary superior not reaching first labial.

β . Last labial in contact with but one temporal.

γ . Two temporals.

Rostral wide, nostril inferior; caudal scales 18; black.

S. groutii.

Rostral narrow; first labial not rising to eye; caudal scales 15; black lined.

S. phenops.*

Rostral narrow; nostril terminal; first labial reaching eye; caudal scales 26; black lined.

S. melanoterma.

$\gamma\gamma$. One temporal.

Rostral narrow; first labial not rising to eye; caudal scales 15; black lined.

S. signatum.

* The *STENOSTOMA PHENOPS* from Tehuantepec is represented by numerous specimens, which are of small size and dark colors. Scales in 13 rows. The eye is distinct, and the nareal suture extends to the rostral plate. The lower surfaces are without marking, but the scales of the upper surface are black with pale borders. There are three white spots; one on the end of the rostral plate; one at the apex, and one on the under side of the tail. Total length, m. .156; tail, .009. The same species was obtained from near Coban, Guatemala, by Henry Hague.

The *Stenostoma melanoterma*, Cope, of the above table, was brought from Paraguay; see Proceed. Acad. Philada. 1862, p. 350. The *S. groutii*, Cope, is a new species, discovered by Dr. Alden S. Grout, near the Umvoti Mission, Zulu Country, South Africa. Scales in fourteen rows. The nasal plate is much narrowed at the labial border, and the first labial only rises as high as the nostril, which is half way from the edge of the lip to the orbit. Color uniform black, except a white spot at vent and one at apex of tail. Dedicated to Dr. Grout, who has sent numerous valuable specimens from the Zulu Country to Philadelphia.

$\beta\beta$. Last labial united with two temporals.

First labial not reaching eye.

S. goudottii.

ASINEA.

66. XIPHOSOMA ANNULATUM, sp. nov.*

Scales in fifty-four longitudinal rows on the body, and in forty-two at two inches behind the head. The top of the muzzle is covered with about fourteen small shields, of which two, a little larger than the rest, separate the nasals and bound the rostral. The latter plate is higher than wide, and has two long sutural borders on each side, and a short one on each side of the apex. Top of head covered with small smooth scales, of which twelve may be counted between the eyes, with superciliaries not distinguishable. The superior labial shields number fourteen, and are all pitted; only the posterior two-thirds of the inferior labials are pitted. Three loreal plates and one preocular; one series of scales separate the orbit from the labials, and bound the labial pits above. Gastrosteges 260; anal entire; urosteges 82.

Ash-colored, with darker ash-colored oval figures on each side. These are simply rings vertically placed, and they are occasionally connected on the median line above, where their color is more distinct. Head and lower surfaces uniform.

	M.
Total length . . . . .	.755
Length of tail . . . . .	.132
“ to rictus of mouth . . . . .	.079

This species exhibits the lip-pits and scutellation of the *X. caninum*, with the squamation and colors of the *X. hortulanum*.

* XIPHOSOMA RUSCHENBERGERII, sp. nov.

Scales in forty-seven rows on the body, and thirty-five rows two inches posterior to the head. Rostral plate higher than long. Superior labials all strongly pitted to the side of the rostral above, and on the posterior half below. The pits below the orbit are not separated from the latter by the projection of the row of scales above the labials, but these are enclosed in the pits which are thus continuous with the orbit. Top of the head covered with large scuta, the largest each subtriangular and separating the nasals. These are followed by a series of scuta above the canthus rostralis, which terminate in two or three large superciliary plates. The latter are separated by smaller scuta, the whole number between the orbits being in nine longitudinal rows. Only two loreals, and one preocular. Yellowish-brown, with occasional yellow scales above. Below bright yellow, on each side of the gastrosteges a series of brown spots. Tail black with yellow spots. Size of the *X. caninum*.

This species resembles the *X. hortulanum* more than the other species, but differs in the larger scales, large plates of the head, the pitted upper lips, and the coloration. There are fourteen rows of scales between the eyes in that species.

Obtained at Panama by Dr. W. S. W. Ruschenberger, President of the Academy, to whom the species is, with much pleasure, dedicated.

67. *EPICRATES CENCHRIA*, Linn., Dr. Van Patten.

68. *BOA IMPERATOR*, Daudin.

Not an uncommon species from the east coast to the foot of the mountains.

69. *LEPTOGNATHUS ANNULATA*, Günther, Annals and Magaz. Nat. Hist. 1872.

Not seen by me.

70. *LEPTOGNATHUS ARGUS*, Cope, sp. nov.

Body compressed; scales in fifteen rows, smooth, larger above than on the sides, the median row not abruptly larger than those adjoining it. Head wide, muzzle very short, orbit bounded in front by the loreal and prefrontal scuta. Rostral plate triangular, as high as wide, very small; internasals small, prefrontals large. Frontal and occipitals large, the former with parallel sides equal to the anterior border. Superior labials seven, orbit bounded by the fourth, fifth, and sixth. Inferior labials seven, the first, second, and third smaller than those that follow, the first pair not uniting behind the symphyseal. Genieal plates three pairs, the anterior two each longer than wide, the third quadrate, smaller. Postorbitals two, temporals 1-2. Gastrosteges 212; anal entire; urosteges 121.

	M.
Total length . . . . .	.345
Length of tail . . . . .	.104
“ to rictus oris . . . . .	.007
Width of head behind . . . . .	.007

Color above from the third row of scales greenish-ash, with two series of alternating light ocelli with black borders. Below, yellow to the third row of scales; the sides below that row with a series of black-edged ocelli like those of the back. Below, blackish speckled on the posterior half of the length. A large black-bordered ocellus on the nape. Head vermiculated with black; lips yellow, with black specks.

This species belongs to the same group of the genus as the *L. anthracops*, Cope. From Sipurio.

71. *LEPTOGNATHUS PICTIVENTRIS*, Cope, sp. nov.

Belonging to the same group of the genus as the *L. argus*, i. e. with the vertebral series of scales not enlarged; scales smooth, and a pair of elongate colubriiform genieal shields. It differs in the peculiarity that the front of the long genieals is in immediate contact with the wedge-shaped symphyseal. Scales in fifteen series, the lateral smaller. The muzzle is not so short as in the *L. argus*, but more as in *L. nebulata*. Internasals transverse triangles; frontal wide, occipitals long. Nasal undivided; orbit bounded by the prefrontal above, the loreal medially and a preocular below. Postoculars two, the inferior separating the seventh labials from the

orbit. Superior labials eight, fifth and sixth bounding orbit, the sixth the longest, the seventh the widest plate, the four anterior higher than wide. Temporals 1-2. Inferior labials seven, four anterior smallest. Three pairs of geneials, two posterior pairs short, wide.

The colors of this species have been somewhat injured by spirits. The belly is yellow, with brown cross-bands on the anterior part of the body, the posterior part with large alternating brown spots. Back, at some points at least, crossed by continuations of the same. Throat and lips brown spotted. Urosteges 121.

This species differs from the last in the arrangement of the head plates both superior and inferior, as well as in the coloration.

72. *LEPTOGNATHUS NEBULATA*, Linn.

The dark colored variety.

73. *DIPSAS GEMMISTRATUS*, Cope, Proceed. Academy Philadelphia, 1861, p. 296; Van Patten.

74. *DIPSAS CENCHOA*, Linn.*

75. *SIBON ANNULATUM*, Linn.

With twenty-one rows of scales. From Old Harbor.

76. *OXYRRHOPUS PLUMBEUS*, Wied. *Brachyrhyton plumbeum*, Dum. Bibr.

I had occasion to observe on a former occasion that this species is a devourer of snakes, having received a specimen from Martinique which had swallowed the head and part of the body of a fer de lance (*Bothrops lanceolatus*). The present collection contains a specimen of m. 1.950 in length which had swallowed a *Her-*

* *TRIMORPHODON COLLARIS*, Cope, sp. nov.

Scales in twenty-three longitudinal rows; posterior geneials very short, separated by an intervening scale. Superior labials nine, fourth and fifth entering orbit. Loreals three; oculars 3-3; temporals 3-3-4-5. Head short and wide; internasal plates small; frontal in contact with superior preocular, and about as long as occipitals.

Body compressed, tail one-fifth the total. Ground color white (or ? yellow), crossed by sixteen black spots on the body in the type specimen (No. 148). The anterior three or four of these are longitudinally extended (the third, eleven scales long); the others are transverse diamond-shaped, the lateral apices extending well on the gastrosteges. Each is divided transversely by a narrow white line. Between each pair of spots is a small black spot on the border of the gastrosteges. Middle line of belly unspotted. Head black above, muzzle and lips yellow; a large projection of the yellow collar occupies a space on each side of the common parietal suture.

Orizaba, Vera Cruz; Dr. Sumichrast.

After examination of a large number of specimens of the genus *Trimorphodon*, Cope, I can recognize five species, viz.: *T. tau*, Cope; *T. upsilon*, Cope; *T. collaris*, Cope; *T. lyrophanes*, Cope, and *T. biscutatus*, Dum. Bibr. The last-named authors describe the *T. biscutatus* as having twenty-three series of scales, and I therefore on a previous occasion regarded it as unknown to me, and named the most common species of Central America and Mexico as *T. major*. I believe, however, that the latter is most probably the species of Duméril and Bibron, and that the number of scales given by those authors is not correct, as I find twenty-five and twenty-seven rows in the numerous specimens at my disposal.

petodryas carinatus of m. 1.970 in length, forty-two inches of the victim projecting from the mouth of its captor. As is necessarily the case, in both instances the captured snake had been seized by the muzzle, and so prevented from biting. Where venomous snakes are abundant the introduction of this harmless *Oxyrrhopus* would materially lessen their numbers. According to Mr. Gabb, it is a spirited and irascible species, making fight when attacked by man.

77. *OXYRRHOPUS PETOLARIUS*, Linn.

Red with subequidistant black half rings; muzzle black. Preocular not reaching frontal; two temporals in contact with postoculars. From Sipurio, the most northern locality for this snake.

78. *DRYIOPHIS BREVIROSTRIS*, Cope, Proceed. Academy Philadelphia, 1860, p. 555.

Similar to the type specimen, but with the scales nearly smooth. They are in fifteen series, the smaller lateral graduating into the larger dorsal. Muzzle rather short, nasal plate very narrow. Preocular reaching frontal. Labials six, eye resting on fourth, third entering the orbital ring. Postocular one, temporals 1-2. Seven inferior labials, first pair with long common suture, nearly equalling pregenaeals, which are longer than postgenaeals. Length m. .563; of tail .220. Color blue, paler below; lips yellowish. Body compressed, gastrosteges rounded.

From Gabb's collection. Typical examples from Dr. Van Patten.

79. *DRYIOPHIS ACUMINATUS*, Wied.

80. *LEPTOPHIS AERUGINOSUS*, Cope, sp. nov.

The genus *Leptophis* has been called *Ahaetulla* by Dr. Günther, and *Thrasops* by Dr. Hallowell. The former name was given by Dr. Gray in 1825 to the genus subsequently named *Dendrophis* by Boie, and, as I showed in 1860, must be retained for it. In Dr. Gray's list of species of *Ahaetulla*, not one is a member of the genus *Leptophis*. In the same year Bell gave the name *Leptophis* to a mixture of species of the two genera in question, commencing with an *Ahaetulla* (Gray). Having at one time adopted the rule of accepting the first species named by an author under a generic head as its type, I referred *Leptophis* to *Ahaetulla*, Gray, as a synonym, and employed *Thrasops*, Hallow., the name next in order of date. Having long since abandoned this position in favor of the more practicable one of regarding as the type of an author's genus the species remaining after the subtraction of all genera based on component species at prior or later dates, the name *Leptophis* remains for the species included by Bell, which are not *Ahaetullæ*. This course has been adopted by Duméril and Bibron.

Scales in fifteen series not keeled, but finely striate. Ventral scuta with very faint lateral angulations well separated from each other. Loreal present, subquad-

rate; preocular scarcely reaching frontal; postoculars two; temporals 1-2; nasal plate not elongate. Superior labials nine, fifth and sixth entering orbit. Inferior labials ten, six in contact with geneials, of which the posterior pair is the longer. Parietals bounded by small scales behind. Gastrosteges 146, anal divided; urosteges 142. Total length .405; of tail .155 m. Golden-brown above, or yellowish-green without the epidermis; vertebral line yellow on one row of scales for the anterior half of the body. Below blue, fading to yellowish on the gular region. A black band from eye along top of last superior labial.

From the low country.

81. *LEPTOPHIS SATURATUS*, Cope, sp. nov.

Scales in fifteen rows, one on each side of the median vertebral, weakly keeled; scales of the lateral rows wider than those of the median dorsal series. Gastrosteges not angulate. Head short and wide, eye large, its diameter equal to the length of the muzzle, or the width of the frontal with one superciliary plate. Internasals and prefrontals wider than long, the frontal, superciliaries, and parietals wide for the genus, the last openly emarginate behind. Nasals not elongate, the anterior the higher; loreal present, nearly twice as long as high; orbitals 1-2, preorbital nearly reaching frontal. Temporals 1-2, the anterior large. Labials nine above, the fifth and sixth bounding the orbit; ten inferior labials, six in contact with the geneials. Gastrosteges 160; anal divided; urosteges 133.

	M.
Total length . . . . .	.880
Length of tail . . . . .	.340
“ to rictus oris . . . . .	.022
“ to orbit . . . . .	.007

Color in spirits, indigo blue, very dark on head and vertebral rows of scales. Lips dark green, a blackish shade above the labial plates from the orbits posteriorly.

The last maxillary tooth of this species is much longer than those that precede it without interval.

The wide and depressed head as well as the smooth scales and color, distinguish this species from the *L. mexicanus*, D. B. The muzzle, and hence the scuta, are less elongate than in the *L. depressirostris*, Cope.

One specimen from Sipurio.

82. *LEPTOPHIS MEXICANUS*, Dum. Bibr.

Valley of Costa Rica; Dr. Van Patten.

83. *LEPTOPHIS PRÆSTANS*, Cope, Proceed. Academy Philada. 1868, p 309.

Sipurio.

84. *DENDROPHIDIUM MELANOTROPIS*, Cope, sp. nov.

The genus *Dendrophidium* was first defined by the writer in the Proceedings Philada. Academy, 1860, p. 561. Its dentition is isodont and coryphodont, in which, with its two preoculars, it resembles *Bascanium* (*Masticophis*). From this genus its strongly keeled scales separate it. Its type is *Herpetodryas dendrophis* of Schlegel: a second species is *H. brunneus*, Gthr., from Equador.

Posterior maxillary tooth a little longer and much stouter than the anterior teeth, the three or four preceding teeth forming a graded series of intermediate size. Scales in seventeen series, all keeled excepting the inferior two on each side; the lateral scales wider than the median; the keels of the row on each side of the vertebral stronger than those of the others. Gastrosteges not angulate. Head elevated, eye large, its diameter one and a half times in the length of the muzzle, and equal to the width of the frontal and one superciliary shield. Superior labials nine, the fourth, fifth, and sixth entering the orbit. These plates are rather small to the eighth, which is much longer than high, and the ninth, which is higher than long. Rostral plate not protuberant, wider than high; postnasal higher than prenasal. Loreal much longer than high, angulate above owing to the oblique suture with the superior preocular. Preoculars two, the superior wide, not reaching the frontal; the inferior much smaller, resting on the middle of the fourth superior labial; on one side united with the superior preocular. Postoculars two, equal, narrow and elevated. Temporals 2-2, short and deep. Internasals longer than wide; prefrontals longer than wide; frontal bell-shaped, wide in front, contracted behind; superciliaries rather narrow. Parietals wide, remarkably short, their greatest length equal to that of the frontal, less than that of the superciliary; their posterior borders convex, including a notch. Scales behind them smooth. The scales of the body are biporous, the pores situated at a distance in front of the apex of the scale, and dark pigmented. Gastrosteges 152; anal divided; urosteges 94.

Color above and including the external fourth of the gastrosteges green; the skin between the scales and the keels of the median three dorsal rows, black; lower surfaces light yellow.

	M.
Total length	1.240
Length of tail . . . . .	.365
“ to rictus oris . . . . .	.035
Width between supercilia . . . . .	.072
Diameter of eye . . . . .	.008

85. *DRYMOBIUS MARGARITIFERUS*, Schlegel.
San José.

86. *DRYMOBIUS BODDAERTII*, Seetz.
Talamanca and San José.

87. HERPETODRYAS CARINATUS, L.

Color black above, below yellow, the former encroaching on the latter and obliterating it on the posterior part of the belly, and on the tail.

[illegible]

The only specimen of this snake was taken from the stomach of an *Oxyrrhopus plumbeus* of one foot less length. The tail and a portion of the body projected from the mouth of its captor. From the low country.

88. HERPETODRYAS GRANDISQUAMIS, Peters; *Spilotes grandisquamis*, Peters, Monatsberichte K. Akad. Berlin, 1868, p. 451.

89. SPILOTES PULLATUS, Linn.; *Coluber variabilis*, Wied.; *Spilotes variabilis*, Dum. Bibr.

90. *SPILOTES CORAIS*, Cuv., Günther, Catal. Colub. Snakes Brit. Mus. 1858, p. 98; subspecies
MELANURUS, Dum. Bibr.

This form ranges from Panama to northern Mexico, preserving the oblique black mark on the neck and the black tail. When the black involves the entire body and head, it becomes the subspecies *S. c. erebennus* (*Spilotes erebennus*, Cope;

Coluber obsoletus, Holbr., not Say). This subspecies extends from the Rio Grande to Alabama.

San José and Talamanca.

91. *SPILOTES CHRYSOBONCHUS*, sp. nov.

Scales in twenty-five series, all smooth excepting the row next the vertebral, which is weakly keeled. Head flat; orbit large, contained 1.66 times in side of muzzle, and 2.25 times in space between their superior borders. Rostral plate broad as high, not protuberant; nasals large, subequal. Loreal small, longer than high; preocular 1-2, the anterior wide, not reaching the frontal. Postoculars subequal, bounded by two temporals. Internasals wider than long, frontal longer than wide in front, little shorter than parietals; latter rounded behind. Temporals 2-2-2, one long, one bounding two upper temporals below. Superior labials seven (a partial division into eight on one side of one specimen); third, fourth, and fifth bounding the orbit. All of them low, the sixth not triangular, the seventh on both sides of two specimens, more than twice as long as any of the others. Twelve inferior labials, eight in contact with the geneials; first pair large, second to sixth narrow and deep; eleventh narrow and longitudinal. Geneials elongate subequal. Gastrosteges 220; anal entire; urosteges 117. Scale-pores in pairs.

Color brown, the scales dotted with lighter, head darker; one or more borders of the scales black. Upper lip, throat, and anterior part of the belly, yellow remainder of lower surfaces passing from brown to black below the tail. The only markings are small black dots on the two lower rows of scales, commencing at the neck and extending to the end of the anterior fourth of the length.

Total length	.	.	.	.	.	.	.	.	.	M.
										1.670
Length of tail	.	.	.	.	.	.	.	.	.	.422
" to canthus of mouth	.	.	.	.	.	.	.	.	.	.040

From the coast region.

This species is evidently near to the *S. fasciatus*, Peters. There are many trivial differences to be found in the description of the latter, and a few of importance. The frontal of *S. chrysobonchus* cannot be said to be "very wide," and it is not in contact with the preorbitals, as in *S. fasciatus*. The parietals are not truncate, and the dorsal scales are not so much keeled as in the latter. In *S. chrysobonchus* the number of gastrosteges exceeds that of the urosteges by 103; in *S. fasciatus* by only 59. The coloration is materially different, the latter having black cross-bands, spots, etc.

92. *LIOPHIS EPINEPHELUS*, Cope, Proceed. Academy, Philada., 1862, Feb.

San José; Dr. Van Patten.

93. *CONOPHIS LINEATUS*, Dum. Bibr.; *Tomodon lineatus*, Dum. Bibr.; *Conophis lineatus*, Cope, Proc. Acad. Philada. 1871, p. 204.

San José; Dr. Van Patten.

There are five species of this genus, distributed from Costa Rica to Yucatan, which differ as follows:—

I. Seven upper labials;

α. Temporals in two rows; loreal higher than long.

Body without bands, but faint traces of them on first, third, and seventh rows of scales. *C. vittatus*, Peters.

Body banded on third and eighth rows. *C. sumichrastii*, Cope.

Var: second row not covered by lateral band; dorsal bands distinct.

Subspecies *sumichrastii*.

Var: second to fifth and eighth to eighth covered by lateral and median band.

Subspecies *viduus*.

II. Eight upper labials.

α. Two rows of temporals.

Loreal higher than long. Six longitudinal bands, the lower on the first row of scales, two dorsal, none on the belly; head brown yellow banded.

C. pulcher, Cope.

Loreal long, or longer than high; no bands except a short one from muzzle through eye. *C. concolor*, Cope.

α. One row of temporals in front; large ones behind.

Loreal longer than high; bands on all the scales except those of the fifth row on each side. *C. lineatus*, D. & B.

The *Conophis sumichrastii*, Cope, has been found by M. Sumichrast in the western part of Tehuantepec, and near Guadalajara by I. I. Major. The subspecies *C. s. viduus* is also from Tehuantepec, from M. Sumichrast. It is a mimetic analogue of *Coniophanes piceivittis*, Cope, from the same place.

94. *CONIOPHANES FISSIDENS*, Günther, Catal. Col. Snakes B. M., 36 (*Coronella*).

Sipurio and Old Harbor, abundant.

I am acquainted with seven species of this genus from the region north of Panama and south of Coahuila. They may be readily distinguished as follows:—

I. Scales in twenty-five longitudinal rows.

Superior labials eight; three broad longitudinal black bands. *C. piceivittis*, Cope.

II. Scales in twenty-one rows (labials 8).

Sides dark above; a broad dorsal band; light lines on the sides of the nape; belly unspotted. *C. punctigularis*, Cope.

Sides shaded above; no dorsal bands nor abdominal spots; light lines on sides of nape. *C. fissidens*, Gthr.

Lines very indistinct, none on nape; two rows of brown spots on belly.

C. bipunctatus, Gthr.

III. Scales in nineteen rows.

Labials seven or eight; sides dark, a narrow vertebral line; a light band behind each orbit. *C. proterops*, Cope.

Labials eight; sides dark, a broad dorsal band from head; a light band from end of muzzle above eye. *C. imperialis*, B. & G.

Labials seven; frontal plate wide; head black, body red. *C. lateritius*, Cope.

95. *PLIOCERCUS DIMIDIATUS*, Cope, Proceed. Academy Philada. 1865, p. 190.

Tail two-fifths the total length; urosteges 120, nearly equal in number to the gastrosteges—127. Scales in seventeen rows, the median scarcely narrowed. Head very distinct, flat, muzzle truncate. Top of rostral shield round, curved back on the upper plane. Internasals very small; lateral borders of frontal (vertical) nearly parallel, a little shorter than anterior. Occipitals large. Temporals, 1 very narrow, 1 pentagonal, 2. Loreal nearly a rhomb, lower than postnasal; preoculars three, upper not reaching frontal, lower cut from labial. Superior labials nine, fifth and sixth entering orbit; postoculars two, superior in contact with occipital only. Nine inferior labials, sixth largest; geneials equal. Teeth equal.

Red, crossed by fourteen black rings on the body, and eight and a part on the tail. These are separated by nearly equal spaces below, and rather narrower ($3\frac{1}{2}$ scales) above. A black space involves the nape to the tips of the occipital and last upper labial plates and all the last lower, and does not meet on the jugulum. The remainder of the head above black except the anterior part of the frontal and the first, second, and third superior labial shields. Lower labials bordering anterior geneials, with symphyseal, black.

Costa Rica; sent by Charles N. Riotte, correspondent of the Smithsonian Institution: Mus. No. 6363.

96. *RHADINÆA DECORATA*, Gth. l. c. 35 (*Coronella*).

Sipurio; abundant.

The genus *Rhadinæa* is nearly coextensive with *Enicognathus*, Jan, and *Ablabes*, Günther. *Ablabes* of Dum. Bibr. was, however, established on the *Coronella rufula* of Schlegel, which has the prolonged series of gastric hypapophyses, and is therefore quite different, while *Henicognathus* is characterized by a peculiar structure of the mandible, which, so far as I am aware, occurs in only one American species, the *H. annulatus*, D. B. Consequently the majority of species attached to this

genus belong to *Rhadinæa*, as the *E. melanocephala*, D. B., etc. In the description of this last species three are mingled, as I have ascertained both from a reading of the same and from an examination of the originals in Mus. Paris. One of these is our *R. obtusa*, the other is the true *R. melanocephala*, and the third is a species which I described under the name of *Lygophis nicagus*, Cope. Duméril and Bibron give both the Island of Guadaloupe and Brazil as habitats of their species. I suspect, however, that the specimen of *R. obtusa* was accidentally introduced into the jar containing the other two, and that it is confined to South America, where it is not uncommon. It is figured by Jan in his "Iconographie" as the second specimen of *R. melanocephala*. His first specimen of the same as figured is our *Lygophis nicagus*, a serpent with a diacranterian dentition. The true *R. melanocephala* is probably confined to Guadaloupe and the neighboring islands.

It is probable that the *Dromicus tæniatus*, Pet., *D. godmannii*, and *D. loreatus* of Günther, belong to this genus, as does the *D. ignitus*, Cope. The posterior tooth is a little longer than the anterior in most of the species, and when one or two teeth in advance of it are broken off or shed, the result may resemble the diacranterian type of dentition characteristic of *Dromicus*. Dr. Günther expressly states that the dentition of his *D. loreatus* is not of that type. The species of *Rhadinæa* may then be distinguished as follows, with the premise that the characters of those above named are only known to me from the descriptions of the authors who made them known:—

I. Scales in twenty-one rows.

Loreal longer than high; three principal bands, with other less prominent ones between them. *R. godmannii*.*

II. Scales in nineteen rows.

Loreal longer than high; nine longitudinal bands. *R. serperastra*, Cope.

III. Scales in seventeen rows.

α. One preocular.

Loreal higher than long; sides with dark line above; a black-edged pale band from eye to side; head pale, lips spotted. *R. vermiculatriceps*.†

Loreal high as long; three broad brown bands; the light ground color extending to the eye; lips unspotted. *R. fulvivittis*.‡

* *Dromicus godmannii*, Günther.

† *Tæniophis vermiculatriceps*, Cope.

‡ *RHADINÆA FULVIVITTIS*, Cope, sp. nov.

Head small, not very distinct from body. Frontal a little longer than the suture from it to the nasal, and a little shorter than common suture of occipitals, two-thirds as wide as long.

Loreal longer than high; a narrow lateral and broad (sometimes divided) dorsal band; the included band reaching side of muzzle; urosteges 90-108.

R. tæniata.*

Sides with dark border above; an oblique yellow band from eye crossing the last labial; urosteges 60.

R. lachrymans.†

A dorsal band; a yellow band encircling head on labials and nape; a yellow band through orbit to nape.

R. loreata.‡

aa. Two preoculars.

Sides dark above, with a superior pale border, which becomes a yellow band on each side of head to orbit; no dorsal band; lips unspotted.

R. ignita.§

Sides dark above, with superior pale border; two yellow spots on each side of occiput and nape; urosteges 90.

R. decorata.||

97. RHADINÆA SERPERASTRA, Cope, Proceed. Acad. Philada. 1871, p. 212.

This species agrees with those regarded as typical, when the genus was first defined (see Proc. Academy N. Sci. 1868, p. 132). That is, the teeth are equal, the scales smooth and poreless, the anal plate divided, the nasals two, loreal one, and oculars 1-2.

In this serpent the scales are in nineteen series. Superior labials eight, not elevated, fourth and fifth bounding eye. Temporals 1-2-3. Internasals transverse, narrow; postnasal larger than prenasal. Frontal wide, superciliary suture shorter than anterior, total length exceeding that of common parietal suture. Loreal square; geneials subequal. Gastrosteges 164; anal 2, urosteges 78.

Dark brown with six longitudinal yellow or white lines, of which the first and second are brightest. The second dark band is wider than the first and vertebral; and like the third is partly divided by a faint white line. Another white line on each side is produced by a series of dark spots on the ends of the gastrosteges. Labial plates black, yellow spotted. Head dark brown above with a pale shade across frontal and two just behind parietals. Chin and belly yellowish.

Rostral small, low; postnasal higher than long; loreal as high as long. Superior labials eight, seventh highest; temporals 1-1. Inferior labials ten, sixth largest, in contact with middle of postgeneials. Scales poreless. Gastrosteges 177; anal divided; urosteges 91.

Color above fulvous, below fulvous-yellow. The three brown bands extend from the end of the nose to near the end of the tail; the lateral involves the fourth and the half of each adjacent row of scales, and is black edged; the dorsal is three and two half scales wide, and is also black edged. The brown is paler on top of the head, and the ground color is a narrow yellow band to the eye. Lips yellow, like the lower surfaces unspotted.

From Orizaba, Vera Cruz; obtained by Dr. Sumichrast; No. 7075 Mus. Smithsonian.

* *Dromicus*, Peters.

† *Lygophis*, Cope.

‡ *Dromicus*, Günther.

§ *Dromicus*, Cope.

|| *Coronella*, Günther.

98. *ERYTHROLAMPRUS VENUSTISSIMUS*, Wied.

Sipurio.

99. *XENODON ANGUSTIROSTRIS*, Peters, Monatsber. K. Preuss. Akad., Berlin.

Sipurio.

100. *STENORHINA VENTRALIS*, Dum. Bibr., Erp. Gen. vii. 867.

Several specimens from Old Harbor.

The genera related to *Stenorhina* are numerous, and their characters may be tabulated as follows:—

I. Internasal plates wanting.

α . Rostral produced backwards to the frontal.

Nasals and first labial confluent.

Ficimia, Gray.

$\alpha\alpha$. Rostral not separating prefrontals.

Nasals confluent with first labial; anal entire; prefrontals in contact medially.

Sympholis, Cope.

Nasals and first labial distinct; anal divided.

Conopsis, Günth.

II. Internasals confluent with nasal plates.

Dentition glyphodont.

Stenorhina, D. B.

Dentition isodont; rostral shovel-like.

Chilomeniscus, Cope.

III. Internasals and prefrontals distinct.

α . Internasals separated by backward production of the rostral.

Nasals confluent with first labial.

Gyalopium, Cope.

$\alpha\alpha$. Prefrontals separated by forward production of the frontal.

Nasals one, distinct from labial.

Toluca, Kenn.

$\alpha\alpha\alpha$. Prefrontals in contact medially.

β . Dentition isodont.

γ . Subcaudal scutella divided.

No loreal; anal divided; two nasals; rostral produced.

Geagras, Cope.*

* *GEAGRAS REDIMITUS*, Cope, sp. nov.

Head not distinct; muzzle depressed, projecting much beyond the mouth, so that the first superior labial is mostly inferior. Superior face of rostral as wide as length of prefrontals; that of internasals narrower, both pairs much wider than long. Frontal large, wide, and produced behind; parietals as long as frontal, narrowed, bifurcate behind, the notch occupied by a large scale. Superciliary plate small. Nasals elongate, very distinct, the posterior angle produced to the preocular, on one side cut off, forming a loreal. Oculars 1-1, the posterior barely touching by its posterior angle the anterior angle of the single temporal. Labials five above, the eye resting on the middle of the third, which with the fifth is the longest. Inferior labials six, of which three are in contact with the pregeneials, and the fourth and largest with the short post-geneials. The symphyseal is wide, and in full contact with the pregeneials; postgeneials not

A loreal; anal entire; two nasals; rostral produced. *Cemophora*, Cope.

A loreal; anal divided; one nasal; rostral much produced. *Chionactis*, Cope.

A loreal; anal divided; two nasals, rostral obtuse, not produced. *Sonora*, B. & G.

ω . Subcaudal scutella entire.

Rostral produced; scuta normal. *Rhinochilus*, B. & G.

$\beta\beta$. Dentition glyphodont.

Rostral little produced; nasal distinct, undivided. *Ogmia*, Cope.

IV. Prefontals continuous on the middle line.

Internasals distinct; rostral produced. *Ligonirostra*, Cope.

Internasals medially united. *Prosymna*, Gray.

The preceding genera are all Mexican, Sonoran, or from adjoining regions, excepting *Ligonirostra* and *Prosymna* (African). *Ligonirostra*, Cope (Amer. Journ. Sci. Arts, 1863) was formerly called *Temnorhynchus* by Smith, but that name was preoccupied.

There are only two species of *Stenorhina*, but several subspecies, which differ as follows:—

Eight inferior labials, fifth largest. No loreal; narrow cross-bands.

S. kennicottiana, Cope.

Seven inferior labials, fourth largest. Seventeen rows scales; temporals 1–2.

S. degenhardtii, Berth.

Subspecies I. Adults plumbeous-brown; no loreal; young with broad cross-bands.

S. d. ventralis, D. B.

Subsp. II. A loreal; scales above the third row with a black tip; ground color pale brown.

S. d. apiata, Cope.

Subsp. III. Loreal present or absent; five black longitudinal bands on a light brownish ground.

S. d. freminvillei, D. & B.

The *S. d. apiata* is from Tehuantepec, from Sumichrast.

101. TANTILLA MELANOCEPHALA, Linn., Dum. Bibron, vii. p. 859.

From Van Patten's collection.

separated from each other by scales. Scales of the body smooth, poreless, and in fifteen longitudinal rows. Gastrosteges 118; anal double; urosteges 25.

Color very pale yellow, each scale, excepting those of the first row, with a brown apical spot, which is in all except the two outer of these, continued to the base of the scale as a brown line. Head above dark brown, with an oval yellowish ellipse surrounding the middle portions, passing round the muzzle and superciliary, and through the length of the parietal plates as a wide band. Below unspotted. Total length m. 166; length to rictus oris, .005; of tail, .020.

Found by Dr. Francis Sumichrast on the west side of the State of Tehuantepec, Mexico, and sent by him to the Smithsonian Institution (No. 8).

To the above description I add that the *Toluca frontalis*, Cope, from Colima, is congeneric with this species in all technical characters.

102. TANTILLA ARMILLATA, Cope, sp. nov.; *Tantilla melanocephala*, var. Cope, Proceed. Acad. Philada. 1871, p. 205.

Form slender; scales in fifteen longitudinal rows. Rostral plate not protuberant; prefrontals three times as long as internasals, equalling the parietal suture of the frontal. Frontal wide, considerably shorter than parietals. Nasals little notched below, the posterior reaching the preocular. Seventh superior labial much the largest; temporals 1-1, the anterior bordering the postoculars. Inferior labials six, first pair slightly united, four in contact with geneials, fourth largest, elongate, touching both geneials. Gastrosteges 166; anal divided; urosteges 50.

Above chocolate-brown; head and nape for five scales, black, with a yellow spot in the individual described, on the end of the muzzle, on the posterior part of each parietal plate; and two on the lip behind the eye, and one below the nostril. The black is bordered behind by a yellow collar of two scales width, which is also bordered by black behind except where it sends off on the third and fourth rows of scales on each side a narrow light band which extends to the tail. Below this, and on the median row of scales, is a narrow brown line. Below immaculate.

Middle Costa Rica; Dr. Van Patten.

The species of *Tantilla* may be distinguished as follows:—

I. Superior labials six; orbitals 1-1.

Muzzle produced; preorbital not in contact with superciliary nor nasal; three longitudinal bands. *T. calamarina*, Cope.

Muzzle less produced; preorbital in contact with superciliary and nasal; temporal one; three bands. *T. bimaculata*, Cope.*

Temporals two; no bands. *T. gracilis*, B. & G.

II. Superior labials seven; orbitals 1-1.

Coloration uniform. *T. planiceps*, Blainv.

III. Superior labials seven; two postoculars.

α. Postnasals in contact with preocular, or nearly so.

* TANTILLA BIMACULATA, Cope, sp. nov.

Scales in fifteen rows. Rostral strongly protuberant beyond mouth. Nasals little notched below by first labial; postnasal barely or quite reaching preocular. Frontal large, longer than suture to rostral, not presenting an angle forwards; superciliaries not reduced; parietals about as long as the frontal. One temporal barely touching postocular; fifth upper labial highest. Five inferior labials, first pair widely separated, only three in contact with geneials, third largest in contact with both geneials. Gastrosteges 130; anal double; urosteges 34.

Color light brown with three darker narrow longitudinal bands. Top of head dark colored in continuation of the middle band; on each side of the occipital plate behind a large yellow spot. Below immaculate.

This well-marked species was found near Mazatlan by Mr. Bischoff, and is No. 6834 of the Smithsonian Catalogue.

β . Posterior labials elevated, separated from parietals by one temporal. Form slender; a yellow, black-bordered collar near parietal plates. *T. miniata*, Cope.

$\beta\beta$. Posterior labials elevated, bounded above by two temporals. Labials higher; first inferior labials separate; black with wide yellow collar.

T. moesta, Gthr.

Frontal narrower; posterior labials higher; body banded. *T. melanocephala*, Linn.

Frontal wider; posterior labials lower; body uniform red. *T. rubra*,* Cope.

$\beta\beta$. Posterior labials low, bounded above by two temporals.

γ . Inferior labials of first pair in contact on the middle line.

Postnasal very small; collar far behind head; body banded; urosteges 51.

T. armillata, Cope.

Postnasal large; collar crossing parietal scuta; body unicolor. *T. coronata*, B. & G.

$\gamma\gamma$. Inferior labials separated by symphyseal.

Urosteges 67; postnasal large, bounded below by first labial; a yellow collar.

T. reticulata, Cope.

Urosteges 57; postnasal chiefly bounded by second labial; head black, no collar.

T. nigriceps, Kenn.

Urosteges 39; first labial rising to nostril; head and body uniform.

T. canula,† Cope.

* TANTILLA RUBRA, Cope, sp. nov.

Scales poreless, in fifteen rows. Rostral plate little prominent; frontal wide, its anterior borders longer than its superciliary, and forming together an anterior angle. Superciliaries well developed; parietals much longer than frontal, notched behind. Nasals strongly notched below for the first labial; the postnasal barely touching the large preocular by its angle. Last three labials elevated, the seventh most so; temporals 1-1, the anterior in contact with postoculars. Only six inferior labials, first pair in contact, the fourth largest, elongate, and in contact with genae of both pairs. Gastrosteges 149; anal divided; tail injured. Length of head and body m. .310. Color red; top of head black, followed by a yellow collar which involves the extremities of the parietal plates, and is followed by a black collar three scales wide. A pale spot below nostril and one on lip behind orbit. From Dr. Sumichrast, from Japana, Tehuantepec.

† TANTILLA CANULA, Cope, sp. nov.; *Tantilla vermiformis*, "Hallow.;" Cope, Proceed. Academy Philada. 1866, p. 126.

This small species is represented by two specimens (Nos. 413 and 737) taken by Arthur Schott in Yucatan, while attached to the Comision Scientifica under the direction of Governor Illaregui. Comparison with four of the *T. vermiformis* of Hallowell establishes the specific difference of the two in a satisfactory manner.

Scales in fifteen rows without apical pores; muzzle rather wide, but projecting beyond the mouth. Internasals and prefrontals narrow, transverse, frontal rather small, longer than suture to rostral, to which it presents an angle. Superciliaries rather large; parietals longer than frontal, notched behind. Temporals 1-1; eye over suture between third and fourth labials; seventh labial the largest. Postgenae short, in contact with each other. Fourth labial below, the largest, in contact with pre- and postgenae. Color leaden, darker above. Head shields with paler borders and centres. Gastrosteges 110; anal divided; urosteges 37. Total length m. .172; of tail .037.

Urosteges 25; nasals not interrupted by first upper labial; head dark with a pale occipital spot. *T. vermiformis*, Hallow.

αα. Postnasals separated from preocular by a wide space.

No loreal; last upper labial larger than sixth; body above with black and white half-rings. *T. semicineta*, D. & B.

A loreal; last upper labial smaller than sixth; body with complete black and white rings. *T. atrocincta*, D. & B.

103. *MICRODROMUS VIRGATUS*, Günther, Ann. Magaz. Nat. Hist. 1872, Pl. IV.

Unknown to me.

104. *NINIA ATRATA*, Hallow.; *Streptophorus drozii*, Dum. Bibr.

San José; Dr. Van Patten.

105. *NINIA SEBÆ*, D. & B.; subspecies *MACULATA*, Peters, Monatsber. K. Preuss. Akad. 1861, p. 924.

Subspecies *TESSELLATUS*, Cope.

This distinct color variety resembles the typical in squamation, as in the nineteen rows of scales all keeled, seven superior labials with the third and fourth entering the orbit, and in the four lower labials in contact with the geneials. The color above is a rosy brown, marked with numerous transverse bands of black with zigzag borders, as the color covers entire scales. Neck of the same ground color; head above brown. Lower surfaces black, with square ? red spots on the gastrosteges. This portion of the coloration is quite distinct from that of the *N. s. maculata*, or other varieties.

106. *CONTIA PACHYURA*, sp. nov.

Scales smooth, in seventeen longitudinal rows, generally poreless, sometimes with one pore. Head rather elongate, rostral plate not prominent; internasals wider than long; prefrontals long as wide. Frontal rather elongate, but shorter than the parietals. Nasals oblique; loreal large, higher than long, encroaching on the single preocular, which does not reach the frontal. Postoculars two, smooth, subequal; temporals 1-1. Superior labials eight, the fourth and fifth entering orbit, the posterior rather low. Geneials equal, rather elongate. The tail is long, entering the total length three and three-fifth times, and is thickened to near the end. Gastrosteges 133; urosteges 50. Total length m. .335.

The color is black, the lower lateral rows of scales with a rufous shade. Scales of the first row with gray tips. Head blackish-brown, a black line from eye above labials; latter yellowish, unspotted. Belly yellowish, each scutum with a black extremity.

From Sipurio.

This species is allied to the *C. calligaster*, differing in its physiognomy and coloration as well as in some technical characters. Thus the loreal plate is larger and differently formed, and the tail is longer and stouter. It is less than one-fifth the length in the *C. calligaster*.

107. *CONTIA CALLIGASTER*, Cope, sp. nov.

Form stout, head little distinct. Teeth gradually increasing in length to the posterior, which is smooth. Scales smooth, poreless; one nasal plate, a subquadrate loreal, one pre- and two postoculars. Muzzle narrowed; side of frontal plate longer than the front, not reaching the preocular. Superior labials seven, third and fourth bounding orbit; temporals 1-1-2. Inferior labials eight, fourth and fifth largest, first barely in contact behind symphyseal. Scales acuminate, in seventeen rows. Gastrosteges 152, anal double; the urosteges 46. Pre- and postgeneials equal.

Color above dark brown, with a narrow vertebral black band. Two lateral paler bands, on the first and second and fourth and fifth rows of scales, the space between black. A black band along the ends of the gastrosteges; belly yellow, except a series of black crescents on the median front of each suture. Labials broadly black bordered. Middle line of tail below black. In a second specimen there is an additional superior labial in front of the orbit, and the temporals are 1-2-2. The lateral light lines are wide and indistinct, and the entire base of each gastrostege is black.

From the Pico Blanco.

108. *CATOSTOMA PSEPHOTUM*, Cope, sp. nov.

Scales in seventeen longitudinal rows, keeled except the inferior. Form rather slender, the head moderately distinct. Maxillary teeth extending as far as the posterior border of the first upper labial. Front somewhat convex, internasals four-sided. Frontal with convex anterior suture, and lateral and two posterior sutures subequal. Orbit bounded by the prefrontal and large loreal; nasal undivided. Postorbitals two, temporals 1-2-2. Superior labials six, fourth immediately under orbit, but the third touching it; sixth longest. Inferior labials six, first pair joined behind symphyseal; all these, with the pregeneials, tuberculate (in one specimen). A pair of short postgeneials. Median keels stronger than the others; tail with triangular section. Gastrosteges 162; anal entire; urosteges 73. Color above uniform black; below black with the half or less of an occasional scutum red, forming a tessellated pattern; but few spots on the urosteges.

	M.
Total length . . . . .	.480
Length of tail . . . . .	.128
“ to rictus oris . . . . .	.010
Width of head behind . . . . .	.008

109. *CATOSTOMA DOLICHOCEPHALUM*, Cope; *Colobognathus dolichocephala*, Cope, Proceed. Acad. Philada. 1871, p. 211.

Scales in thirteen longitudinal series, carinate to the urosteges on the tail, to the first row of scales on the posterior, and to the second row on the anterior part of the body. Head elongate conic, scarcely distinct from the neck. Internasals very small, prefrontals very long. Frontal wide, openly angulate in front, with superciliary margins distinct from the parietal; latter plates well developed. Superior labials six, second bounding nasal and loreal; third a little, fourth largely in the eye, fifth longer than high, in contact with parietal. One temporal above sixth labial, which is higher than long. Inferior labials six, second and third minute, fourth long and narrow. Postgenaeals small, separated by a scutum. Oculars 0-1. Rostral elevated, not separating internasals. Tail slender, 5.75 times in the total length. Gastrosteges 131, anal 1, urosteges 39. Color of body above and entire tail, black, a series of large distant red spots on each side, which often meet above, forming half-rings. These disappear on tail and neck. Below red, lower lip and chin black. Length 12-14 inches.

San José, Costa Rica. Dr. Van Patten.

This species differs from the *C. nasale*, Cope (Proceed. Academy, 1868, p. 131), in the fewer scale-rows (the latter has seventeen), the coloration, etc.

110. *CATOSTOMA BRACHYCEPHALUM*, Cope; *Colobognathus brachycephala*, Cope, loc. cit. 1871, p. 211.

Scales in fifteen longitudinal rows, smooth except a faint trace of carination near the posterior part of the body. Head flat, rather wide behind and distinct from neck. Postgenaeals small, separated by a scale. Rostral moderate, internasals not minute, prefrontals nearly as broad as long. Frontal broad, convex in front, superciliary and parietal sutures nearly continuous. Oculars 0-1. Superior labials six, two behind orbit, sixth longer than high, separated by one temporal; fifth longer than high, bounding parietal; third and chiefly fourth in eye. Lower labials seven; genaeals short, wide. Gastrosteges 124, anal 1, urosteges 38.

Color of body above and entire tail, black; gastrosteges reddish, brown margined. A yellowish or orange collar crosses behind the parietal plates and a band of the same color extends from the side of the neck to the tail on the second and third rows in front and third to fifth behind. This band is composed of two rows of alternating narrow spots, which are not always perfectly united.

Total length eight inches, the tail one-sixth of the total.

The species just described agree with the *C. nasale*, the *C. semidoliatum*, and the *Colobognathus hoffmannii*, in having the first labial behind the eye in contact with the parietal shield. They are intermediate in the structure of the jaws, between

the types of the two genera named. In the *C. semidoliatum* the maxillary bone is developed and bears teeth opposite the first labial plate. In the *Colobognathus hoffmannii*, it with the palatine is cartilaginous in front, and bears no teeth anterior to the fourth labial shield. In the *C. brachycephalum* and *C. dolichocephalum*, the maxillary and palatine are better developed, the teeth extending to the posterior margin of the second superior labial. In the serpent described by me (Proc. Ac. Nat. Sci. 1869, p. 131) as *Catostoma nasale*, the dentition is precisely as in the two species here described, while in the *C. bicolor*, Gthr., the character of the dentition is intermediate between them and that of the *C. semidoliatum*. In the genus *Colophrys*, Cope, from Guatemala and Yucatan (l. c. 1868, p. 130), the maxillary is still better developed, the teeth commencing at the anterior part of the second upper labial.

111. COLOBOGNATHUS HOFFMANNII, Peters, Monatsber. K. Preuss. Acad. 1863, p. 214.

PROTEROGLYPHA.

112. PELAMIS BICOLOR, Daudin.

This sea-snake has been now frequently brought from the Pacific coast of Central America since the first note of its occurrence there, Proceed. Academy Philadelphia, 1859, p. 347.

113. ELAPS MULTIFASCIATUS, Jan, Revue et Magazine Zoologie, 1859, Pl. A. Cope, Proceed. Acad. Philada. 1871, p. 209.

San José; Dr. Van Patten.

114. ELAPS ORNATISSIMUS, Jan, loc. cit.

San José; Dr. Van Patten.

115. ELAPS NIGROCINCTUS, Girard, U. S. Astronomical Expedition, II. p. 210, plate.

San José; Dr. Van Patten.

116. ELAPS CIRCINALIS, Dum. Bibron.

Several specimens with the rings varying in number from eleven to eighteen. Scales in the intervals black tipped. Talamanca.

SOLENOGLYPHA.

TELEURASPIDES, Cope, Proceed. Academy Philada. 1871, p. 205.

This group of the rattlesnake family embraces those with undivided anal shields and no rattle. It stands immediately between the true *Trigonocephali* and the *Crotali*, as the former have divided caudal scutella and the rattle absent, the latter possess the rattle with simple scutella. One genus of this division was described

long ago by Beauvois, and adopted by Gray and others, that is the *Ancistrodon* of North America and Mexico, but most of the genera have only been recognized within a recent period. In March, 1859, Prof. Peters distinguished a second genus of the group, and towards the close of the same year the writer named a third. Prof. Peters named another genus, which may be retained, though in a sense quite different from that in which it was originally intended. I allude to *Bothriopsis*, first defined by the four small scuta on the top of the muzzle of one of the species, a character not worthy of such a valuation. The characters adopted will be seen below. All the known species are found between north Mexico and Peru.

I. Head scaled above.

α. Body compressed, tail prehensile (*arboreal*).

A series of horn-like scales above the eye, outside of the superciliary shield.

Teleuraspis.

Superciliary reaching to the edge of the eye opening; no horns.

Bothriechis.

αα. Body cylindric, tail straight (*terrestrial*).

Nasal plate one.

Porthidium.

Nasal plates two.

Bothriopsis.

II. Head with nine plates above.

Body cylindric; two nasals.

Ancistrodon.

117. TELEURAPSIS SCHLEGELII, Berthold, Abh. Wiss. Göttingen, 1847, iii. 13 (*Trigonocephalus*), Cope, Pr. A. N. Sci. 1859, p. 338; 1860, p. 345.

This species is abundant in eastern Costa Rica, and displays three color varieties. All the specimens have twenty-three rows of scales, and some eight, and others nine superior labials. There is no tendency to division of the urosteges. From Ecuador to Costa Rica.

Var. I, *nitida*, Günther, Proc. Zool. Soc. Lond. 1859, nov. Tab. (*Lachesis*), l. c. 345, et 1868, p. 110.

Green with brownish-red vertical bands on each side which usually alternate; belly green and yellow varied with black, punctulate. Ecuador.

Var. II. Green with a series of small brown dorsal spots; below as in Var. I.

Var. III, *nigroadspersus*, Steindachner, Sitzungsberg. Wien. Akademie, 1870, May, Pl. VIII.

Golden yellow; lower surfaces unspotted.

According to the observation of Mr. Gabb, this is a dangerous species, its bite requiring prompt treatment to prevent a fatal result. It is distributed from the coast (Old Harbor) inland to an elevation of 5-600 feet above the sea.

118. *BOTHRIECHIS NIGROVIRIDIS*, Peters, l. c.; Cope, l. c.; Monatsber. K. Preuss. Akademie, 1859, p. 278; Cope, Pr. A. N. Sci. Phila. 1859, p. 345; *Thamnocenchris*, Salvin.

This genus is, like the last, confined to the great forests of Central America and the northwest of South America. Species have been found further north than those of *Teleuraspis*. Like the latter they inhabit trees, filling the place in America of the species of the East Indies which belong to the *Bothropes*, and of the tree-vipers of Africa, *Atheris*, Cope. All the species of these different groups are of green colors, in contradistinction to those of terrestrial habits, which are of various shades of brown. This is evidently related to their convenience in the struggle for existence in the localities in question.

From an elevated point on the Pico Blanco. Mr. Gabb states that it occurs in the central valley also, from which it has been brought by Dr. Van Patten.

119. *BOTHRIECHIS LATERALIS*, Peters, Monatsb. K. Preuss. Acad. 1862, p. 674; *Bothrops bilineatus*, Pet., l. c. 1859, p. 278; ? *Bothrops bicolor*, Bocourt, Ann. des Sci. Nat. 1868, p. 201.

Costa Rica.

120. *BOTHRIOPSIS AFFINIS*, Bocourt, Ann. Sci. Nat. 1868, p. 201; *Teleuraspis mexicanus*, Cope, Pr. A. N. S. 1859, p. 339; *Bothriecheis* do., Cope, l. c. 1860, p. 345; nec *Atropus mexicanus*, D. B.

Mexico, as far north as Tuxpan, and Central America to Costa Rica.

Superciliary shields very narrow; no small scales surrounding rostral. Scales in 23 ("25") rows, three inferior smooth; small scales on canthus, four rows below eye; rostral broad as high; nine superior labials, fourth largest. Twenty-two dorsal rhombs.

The species of this genus are all of terrestrial habits, and approach in this respect the *Ancistrodontes*. They have a more extended range than any of the preceding, occurring from the upper or Peruvian Amazon to northern Mexico. They are very venomous, but not so much dreaded as the true *Bothropes* of the same regions, which attain a larger size.

121. *BOTHRIOPSIS PROBOSCIDEUS*, sp. nov.

A rather small species of sombre colors, allied to the *B. brachystoma*. Scales in twenty-three series, all carinate, the inferior but slightly; those of the top of the head and muzzle not very different in size, also keeled. Superciliary plates each a broad oval, the two separated by five rows of scales, of which the external on each side follows the inner border of the plate. A narrow shield on each side of the end of the muzzle which is bent up at its middle, lying against the posterior side of the rostral plate, and in contact with its fellow, the extremities of the two having a bilobed outline. Rostral plate three times as high as wide, lying against

the plates just described by its upper part, the three forming an erect appendage or short proboscis. Nasal plates distinct, the posterior impressed, the anterior in the plane of the rostral, with an anterior angle produced between the rostral and superior plate of the muzzle. Pit surrounded by small scales; one large preocular. Labials nine above, fifth longest, separated from the orbit by three rows of scales. Lower labials nine, one pair of short geneials, followed by two pairs of shorter scales.

	M.
Total length . . . . .	.310
Length of tail . . . . .	.040
“ to rictus oris . . . . .	.015
Width of head at supercilia . . . . .	.008
“ “ “ temples . . . . .	.016

Color yellowish-brown above, blackish below. On the upper surface of the body eighteen quadrate spots divided by a narrow, light vertebral line, and divided in the transverse direction so that each is composed of four spots, which are smaller and most separated on the anterior part of the body. Lips black, the lower with vertical white bars. A brown band from eye to behind angle of mouth, bordered by white in front; a semidiscoid brown spot below eye.

This venomous snake resembles the *Porthidium nasutum* of Bacourt, according to the description of that author, but it is stated to have but one nasal shield, while all of the specimens of the *B. proboscideus* possess two.

Not rare at Sipurio, at the base of the mountains.

TRIGONOCEPHALI.

122. *BOTHROPS ATROX*, Linn.

Abundant in the coast region; one specimen measures six feet, and Mr. Gabb assures me that it reaches eight feet in length. It is the most formidable venomous snake in the country, and is known by the name of Tamagaf. Its bite is generally fatal, unless very promptly treated. Dr. C. R. Lordley, a resident in the country for many years, has saved many cases by the following treatment: He forbids alcohol, and administers fifteen drops of ammonia diluted every quarter or half hour, which, if not speedily beneficial, is replaced by the same amount of tincture of iodine. Salt is especially to be avoided, as well as fresh vegetable food, light animal diet being recommended. Hemorrhage into the stomach and alimentary canal is said to be aggravated by salt. The bowels are to be kept open by sufficient doses of castor oil. The usual violent thirst is not to be quenched by water, but by tea of cinnamon or guaca.

123. *LACHESIS STENOPHRYS*, Cope, sp. nov.

Scales in thirty-six longitudinal series, of which ten on each side of the median line support a central tubercle. The muzzle is short and depressed, and the rostral plate is an equilateral triangle. The superior labials number nine, of which the third is much the largest. The second is low, and does not bound the maxillary pit. The latter is bordered by three scuta; the superior narrow, bounds the two preoculars; the inferior wider, stands on the third labial, and the anterior, which is subcrescentic, and stands on the second superior labial. A trapezoid dorsal bounds the large superior preocular in front. Four rows of scales separate the orbit from the labials. The scales of the top of the head are flat, hexagonal, and faintly keeled; twelve series separate the superciliaries, which are quite narrow. Inferior labials thirteen, the first large, and with the second in contact with the geneials. The latter form but one pair, are squarely truncate in front, and narrowly rounded behind. Gastrosteges 200; urosteges, double 32, quadruple 17; caudal spine well developed. Color (in spirits) fawn brown, with twenty-three reddish-brown median rhombs on the dorsal region. The lateral angles of these are dark spots, sometimes isolated, and do not extend below the fifth row of scales. On the middle of the body the rhombs have pale centres, posteriorly they are darker, and become confluent into a zigzag band. Tail dark brown, with narrow, light cross bands. Lower surfaces all greenish-yellow, except the throat and chin, which are white (in spirits). A black band extends from the eye above the labials, and is broken upon the neck into a series of black spots. Top of head uniform brown.

	M.
Total length . . . . .	.495
Length of tail . . . . .	.050
“ of gape . . . . .	.021

One specimen from Sipurio.

This species is of much interest as increasing our knowledge of the structural and geographical range of the genus *Lachesis*, heretofore represented only by the *L. mutus* of Surinam. As such, it has the distal caudal scutella four-rowed and tubercular.

CROTALI.

124. *CROTALUS DURISSUS*, Linn.; *C. horridus*, Auctor., Pluv.; *Caudisona durissa*, Laurenti.

This large species was not found by Dr. Gabb in Talamanca, but was brought by Dr. Van Patten from the neighborhood of San José.

TESTUDINATA.

125. SPHARGIS CORIACEA, Linn.

Young specimens from Limon, indicating a breeding place for this species.

126. CINOSTERNUM LEUCOSTOMUM, Dum.

Young and adults from Old Harbor and Sipurio.

127. CINOSTERNUM ALBOGULARE, Dum. Boc. Miss. Sci. Mexique, p. 24.

128. PSEUDEMYIS ORNATA, Bell; *Callichelys ornata*, Gray, Supplem. Catal. Shield Reptiles, p. 48.

129. CHELOPUS GABBII, sp. nov.

Form resembling *Testudo*, stout, and with short thick feet with very short webs. Outline of carapace a regular ellipse, the margin not incised, but a little revolute behind and before. Top of shell flat in profile, bearing a well-marked but obtuse keel from nuchal plate to the caudals. Vertebral scuta (in an adult) broader than long, with straight transverse sutures; penultimate narrower behind, the last one the largest of all, wider than long. Plastron flat, turned up at the bridges and in front, strongly notched behind. The anterior lobe is concavely truncate in front, with a tooth-like protuberance at each outer angle; the sides oblique to the axilla. Gular scuta wide, their common suture not longer than that of the humerals.

Muzzle nearly vertical, beak not notched; symphysis recurved, horny alveolar ridge minutely serrate. Forearm with large scales in front, on the outer edge, and in a transverse band behind the wrist. Hind leg with a row of large scales on the inner front of the lower half of the tibia, continuous with those covering the inner toe. Two scales on the outer posterior border of the hind foot, followed by a large one covering the rudimental outer toe, which forms an obtuse process. Tail smooth.

Color above wood brown, middle of plastron from humeral scuta to posterior border darker brown; remainder of lower surfaces, wax-yellow. Head brown above, a faint red band round the muzzle, and a short one on the median line above. A yellowish brown-edged band from the temple to the middle of the neck, and a similar one from the eye to the tympanum. Neck and limbs yellowish, speckled with brown and black; hind legs blackish on the outer side.

										M.
Length of carapace	.	.	.	.	.	.	.	.	.	.186
Width of "	.	.	.	.	.	.	.	.	.	.120
Elevation of "	.	.	.	.	.	.	.	.	.	.060

This essentially terrestrial tortoise resembles the *C. areolatus*, Duméril, and the *C. annulatus* (*Rhinoclemmys*, Gray). The former has a roof-shaped back, and has

the vertebral scuta longer than wide. According to Gray, the keels of the vertebral scuta of the *C. annulatus* are confined to their anterior part, and the colors are materially different. It also resembles the *C. incisus*, Bocourt; but this turtle is represented as without the row of scuta on the inner front of the tibia; the edge of the carapace is strongly dentate, and the gular scuta are much longer, and have a very different anterior margin. I only know this species from the figure and description of Bocourt.

The *Chelopus gabbii* is dedicated to the learned geologist who made the collection here described.

130. CHELOPUS FUNEREUS, sp. nov.

Represented by four specimens, none of which are adult, the largest having a carapace 4.75 inches in length. On examination with the view of ascertaining whether they represent the young of the *C. gabbii*, I find so many distinguishing features as to render it necessary to name them.

As in young tortoises, the carapace is wider than in adults of the same species. It is not revolute and very slightly serrate behind. An obtuse vertebral keel. Plastron notched behind; the anterior lobe with a shallow concavity of the anterior border, the edge on each side of it projecting in three teeth. The free border of the humeral scute is strongly convex behind the gular. The feet are more strongly webbed in this species than in the last, and there are five scuta on the external border of the hind foot, which do not terminate in a large one, since there is no projection representing the outer toe. There is no row of scuta on the inner face of the tibia; but the forearm is plated in front, on the outer edge, and in a band behind the wrist. In the smaller specimens there is a slight notch in the border of the upper jaw, in the larger it is absent. The median suture of the gular scuta is twice as long as that of the humerals. The first vertebral scute is relatively longer than the others, while the last one is only half as large as those that precede it.

Color black on the upper surface of the head, neck, and carapace; plastron black, except a narrow, yellowish border. Throat, limbs, and marginal scuta below, yellowish, black speckled. Outer side of hind legs and feet, and outer edge of fore legs black. Some rows of black spots on the lower jaw and front of fore leg; anterior toes yellow, with black borders. No markings on the upper side of head and neck.

The adult of this species will probably be found to be of very obscure color. It displays unusual tardiness in the ossification of both carapace and plastron, the largest specimen being very soft. It is probably allied to the *Mauremys fuliginosa* of Gray. From Limon.

ART. V.—*On the Batrachia and Reptilia collected by Dr. John M. Bransford during the Nicaraguan Canal Survey of 1874.*

By E. D. COPE.

BATRACHIA.

1. *CECILIA OCHROCEPHALA*, Cope, Proceed. Academy Philada. 1866, 132.
From the Atlantic side of the Isthmus.
2. *MICROPHRYNE PUSTULOSA*, Cope, Proceed. Academy Philada. 1864, 180.
Buchio Soldado.
3. *BUFO HÆMATITICUS*, Cope, loc. cit., 1862, p. 157.
Camp Mary Caretta.
4. *BUFO PLEUROPTERUS*, Schmidt, Denkschriften Wiener Academie, 18.
Buhio Soldado and Camp Mary Caretta.
5. *BUFO AGUA*, Daudin.
6. *HYLA ELÆOCHROA*, Cope, Journal Philada. Academy, 1875, supra, p. 105.
? From the Pacific side.
7. *PHYLLOBATES RIDENS*, Cope, loc. cit., 1866, p. 131.
8. *LITHODYTES DIASTEMA*, Cope, sp. nov.

Approximating *Phyllobates* in the slight development of the vomerine teeth, and further characterized by the shortness of its feet. The former are in two very short transverse patches behind and within the line of the middle of the choanæ, and separated by an interspace as wide as the length of each. The tongue is obpyriform, rounded and extensively free behind. The *ostia pharyngea* are minute. The *membranum tympani* is indistinct, with a diameter of less than half that of the eye slit. The head is an oval in outline, with narrowly truncate and depressed muzzle. The canthus is obtuse, but not concave. Nares subterminal; diameter of orbit about equal length of head in front of it. Cranium above slightly convex in both directions.

The toes are short, and the digital dilations are large on all the feet. On the anterior the first toe is shorter than the second. On the posterior the fifth is longer than the third, and reaches the base of the penultimate phalange of the third. The muzzle marks the wrist and the middle of the tibia of the extended limbs.

Color above dark brown; a darker brown between the eyes, which is paler bordered anteriorly. Below, pale brown.

	M.
Total length . . . . .	.0200
Length to axilla . . . . .	.0090
“ to tympanum . . . . .	.0060
Width head at tympanum . . . . .	.0070
Length of fore limb . . . . .	.0115
“ of fore foot . . . . .	.0035
“ of hind limb . . . . .	.0270
“ of hind foot . . . . .	.0120
“ of tibia . . . . .	.0085
“ of tarsus . . . . .	.0060

This species resembles the *Lithodytes habenatus*, Cope (supra, p. 109), in the position of the vomerine teeth, but differs much in the form of the feet. In that frog the dilatations are much smaller and the feet much longer. In the hind foot this is chiefly due to the elongation of the fourth toe, which exceeds the third and fifth by three and a sixth phalanges.

The *Lithodytes diastema* was found by Dr. Bransford at the camp Mary Caretta, Panama.

LACERTILIA.

9. CORYTHOPHANES CRISTATUS, Merrem.

Buhio Soldado.

10. BASILISCUS GUTTULATUS, Cope, sp. nov.

Represented by a young male, which displays a number of remarkable characters. The back and median line of the tail support the membranous crest stretched between the elongate neural spines as seen in *B. plumifrons*, *B. mitratus*, etc., but the head-crest, instead of being covered, as in those species with large thin scales, presents only small smooth scales like those of the occipital region. This crest is also of smaller size than in the species named, only beginning to rise from a line connecting the tympanic drums, although preceded by a keel to near the line of the border of the orbits. It is not much elevated, but is prolonged chiefly backwards, and has a truncate posterior outline. Points in which the species differs from the *B. cristatus* are, the presence of two large scuta bounding the rostral shield above, and the presence of two large labials behind the point of junction with the suborbital ring of scales. There are only ten rays to the dorsal fin, and

fifteen to the caudal, the latter graduating imperceptibly to the usual keel. Neither crest is bordered at the margin with large scales. The ventral scales are entirely smooth, while the dorsals are smaller and keeled; the lateral are smaller still.

Color olivaceous-brown above, shaded with leaden on the sides; yellowish below. A few black spots at the base of the dorsal crest. Sides and throat with small black spots. A black band from eye to tympanum, bordered with yellow below. Hind legs and feet with brown, yellow-bordered cross-bands.

	M.
Total length . . . . .	.455
Length to vent . . . . .	.125
“ to axilla . . . . .	.060
“ to tympanum . . . . .	.030
“ to orbit . . . . .	.012
Width between orbits . . . . .	.016
Length of fore limb . . . . .	.060
“ of hind limb . . . . .	.130
“ of hind foot . . . . .	.063

From camp at Buhio Soldado, Panama.

11. *ANOLIS TROCHILUS*, Cope, Proceed. Academy Philada., 1871, p. 215.
Buhio Soldado.
12. *ANOLIS PETERSII*, Bocourt, Miss. Scient. Mexique, p. 79,
Station 19.
13. *ANOLIS CAPITO*, Peters,
Rio Frijole.
14. *AMIVA PRÆSIGNIS*, Bd. Gird.

OPHIDIA.

15. *SPILOTES CORAIS*, L.; subspecies *MELANURUS*, Dum. Bibr.
16. *XENODON ANGUSTIROSTRIS*, Peters.
Camp Mary Caretta.
17. *SIBON ANNULATUM*, Linn.
From the Atlantic side.
18. *TELEURASPIS SCHLEGELII*, Berth.
From the Atlantic side.

Total number of species obtained by Dr. Bransford, eighteen.

ART. VI.—*Report on the Reptiles brought by Professor James Orton from the middle and upper Amazon, and western Peru.*

By E. D. COPE.

THE following pages contain a list of the species as expressed in the above title, including descriptions of such as have not been previously known to zoology. A report on the Batrachia obtained by Prof. Orton has already appeared,* which included thirty-six species; of these fourteen were believed to be new. The present list embraces seventy-four species, of which seventeen are new. The *Lacertilia* number thirty-three species, the *Ophidia* forty-one.

The localities at which the greater number of species were obtained are: Santarem (on the lower Amazon); Solimoens (or middle Amazon); the Marañon (or upper Amazon) at several points, viz., near the mouth of the Napo, at Iquitos and Nauta on the Peruvian and Ecuadorian borders; on the Huallaga between Balsa Puerto and Moyabamba, and near Moyabamba and Rioja, Peru. A few specimens were obtained near Lake Titicaca, which represent three species, viz.: *Cyclorhamphus amaricus*, Cope; *Tachymenis chilensis*, Schlegel; and *Proctotretus multiformis*, Cope. These all belong to genera of the Pacific side of the Andes, none of which are known from east of that range, and the *Tachymenis chilensis* is the commonest snake of Chili and western Bolivia. The indications respecting the fauna of eastern Peru furnished by Professor Orton's collections are, that it differs in no essential respect from that of the great Amazon valley.

The Peruvian species were mostly derived from the valley of Jequetepeque, which extends from the Cordillera of Caxamarca to near the coast at Pacasmayo. They are sixteen in number, and include type forms of the West Coast Fauna in the genera *Microlophus* and *Craniopeltis*.

LACERTILIA.

LEPTOGLOSSA.

1. *MABUIA CEPEDAI*, Gray; Cope, Proceed. Academy Philada. 1862, p. 186.

Nauta.

2. *MAUBIA SURINAMENSIS*, Hallowell, Cope, loc. cit.

From the Marañon near the mouth of the Napo.

* Proceedings Academy Philada., 1874, p. 120.

3. *PROPUS VERMIFORMIS*, Cope, Proceed. Acad. Philada. 1874, p. 70.

From Nauta.

4. *LEPIDOSOMA CARINICAUDATUM*, Cope, sp. nov.

Scales large, angulate, strongly keeled on the back and sides; four abdominal rows with the keel reduced to an angle and mucro, otherwise like the dorsal scales. The dorsals are a little larger than the ventrals, and these a little larger than the inferior lateral. A few small scales in the groin and axilla, and above the humerus. No granular scales on the side of the neck, but keeled scales between the arm and ear. Nuchal scales like the dorsal; the gulars a little smaller than the ventrals, keeled and mucronate. Four superior rows of caudal scales strongly keeled, forming four continuous ridges. Two lateral rows weakly keeled; four inferior series strongly keeled, forming ridges. Twenty-six oblique rows of scales between occiput and posterior line of femora; twenty-seven between infralabials and femoral pores, and twenty-one in a circle round the body. Two large preanal scuta, each flanked by a small lateral, and preceded by an oval median scale, which has a small one on each side.

The frontonasal plate is broader than long; the prefrontals not extensively in contact, and the frontal is twice as long as wide. The frontoparietals are largely in contact, and the parietals and interparietals are longitudinal and subequal in size. Two loreals, one above the other, no preoculars; five supraoculars and four supra-orbitals. The temporal scales small, smooth; larger and keeled behind. Cranial plates behind the prefrontals with one or two linear ridges. Three pairs of very large infralabials, a row of granules only separating the last pair. Eleven femoral pores on each side. The diameter of the oval meatus auditorius is equal to that of the eye-slit. The limbs are covered with large keeled scales, except the postero-inferior faces of the femur and humerus, which are granulated. The limbs are short, the anterior reaching the middle of the orbit, the posterior five-sixths the distance to the axilla. Thumb clawed.

	M.
Total length (tail partly renewed) . . . . .	.115
Length to vent . . . . .	.050
“ to axilla . . . . .	.021
“ to ear . . . . .	.011
“ to orbit . . . . .	.003
Width of head at angle of jaws . . . . .	.0085
Length of hind limb . . . . .	.023
“ of hind foot . . . . .	.011

Color above cinnamon-brown, below yellow; sides, from ear to an indefinite point on the tail, black, inclosing a narrow yellow band from axilla to groin. Black on scapular region, pale bordered above. From nape to tail a median series of small black spots. Head brown; throat yellow.

This handsome species differs from the *L. scincoides* of Spix in the absence of a band of granular scales on the sides of the neck, and in the keeled scales of the tail. The coloration is quite distinct. It differs in many specific details from the *Loxopholis rugiceps*, Cope,* besides in the quadrate form of the abdominal scuta, in which that genus differs from *Lepidosoma*.

From the Maranon.

5. *NEUSTICURUS ECPLEOPUS*, Cope, sp. nov.

Scales of the back small and flat, becoming granular on the nape. Mingled with the former are large oval keeled scales in two separate rather irregular series near the middle, and a double row of similar ones on each side. The sides are thrown into vertical folds, which support mingled small and large scales. The nape and sides of the neck are marked by rows of small round warts, of which there are eight between the lines of the tympana.

The abdominal scales are in eight longitudinal rows, the median as broad as long, except at the sides. There is a well-marked collar of seven scales, large in the middle and small exteriorly. In front of this are four or five cross series of large scales, all but the posterior composed of two scales only. The throat is otherwise covered with round, smooth, convex scales. The preanal region is covered with three rows of scales, the anterior two containing two each, the last or marginal including two large, and a small median one. The limbs above are granular, with scattered tubercles; femur and forearm in front, and tibia below, with large scuta. Tail, with whorls of oblong scales with two keeled rows above, which are separated by a few flat scales only.

The head scuta are the usual ones, with the omission of internasals. The parietals are about as large as the frontoparietals, and are separated by a larger interparietal, which projects further backwards, forming with the parietals a nearly rectangular outline, the angle median. Four infraorbitals, five supraoculars. A loreal and upper preocular, which cover part of canthus rostralis. Temporal scales granular. Upper labials seven, four to the coronoid process, large, especially the fourth; fifth subtriangular. Inferior labials four and five to coronoid, of which some two are confluent in the typical specimen. A large postsymphyseal; four

* Proceed. Academy Phila. 1868, 305.

large infralabials, of which three are in contact with the labials, and two pairs with each other. Ear as large as eye opening. Femoral pores fifteen on each side.

Color chocolate-brown above, showing darker spots in proper lights; below yellow, brown speckled, except the throat and chin and lips, which are black.

	M.
Length (tail partly reproduced) . . . . .	.130
“ to vent . . . . .	.066
“ to axilla . . . . .	.033
“ to tympanum . . . . .	.015
“ to orbit . . . . .	.005
Width of head behind . . . . .	.012
Length of fore limb . . . . .	.020
“ of hind limb . . . . .	.030
“ of hind foot . . . . .	.015

The characters which distinguish this species from the long-known and large *N. bicarinatus*, are the larger gular scuta, the smaller occipital and temporal scales, the eight (not six) ventral rows, and the fifteen (not thirty) femoral pores.

The characters of the head scuta of this genus are those of the *Ecpleopidae*; while those of *Thorictis* and *Crocodylurus* are those of the *Teidae*.

6. *CROCODYLURUS AMAZONICUS*, Spix.

7. *CENTROPYX PELVICEPS*, Cope, Proceed. Academy Philada. 1863, 98.

Nauta.

8. *CENTROPYX DECODON*, Cope, loc. cit., 1861, 495.

Santarem, Brazil.

9. *CENTROPYX ALTAMAZONICUS*, Cope, sp. nov.

Dorsal scales very small, hexagonal, smooth, but little larger than the lateral. Ventrals keeled, in sixteen longitudinal rows, and thirty-five transverse to the line of the femoral pores. Two rows of keeled collar scales, the second largest. Gular scales small, equal, and smooth. Four rows of carinate preanal scales, the last composed of six scales.

Internasal scuta barely attaining mutual contact; frontonasal broader than long; mutual contact of prefrontals short. Frontal longer than wide, parietals nearly as wide as interparietal (the specimen young). Two narrow transverse occipitals. Nostril on suture between internasal and nasal; one large loreal, one inferior preocular; six supraoculars, and three supraorbitals. Scuta on the upper

and front sides of humerus, and front of cubitus; other faces granular. Femur and tibia granular above, the former behind also. Inferior tibial scuta keeled. Caudal scuta keeled below, nearly and quite smooth above.

Color of a young specimen bluish, with a median light band from the middle of the back to the end of the nose, covering the muzzle and front as far as the frontoparietal scuta. A light band from orbit to near femur and another from tympanum to groin, the intervening space crossed by vertical black spots and bars. Lower surfaces green immaculate.

	M.
Total length . . . . .	.110
Length to vent . . . . .	.040
“ to axilla . . . . .	.019
“ to ear . . . . .	.010
“ to orbit . . . . .	.004
Width of head posteriorly . . . . .	.006
Length of hind limb . . . . .	.029
“ of hind foot . . . . .	.015

This species is nearer to the *C. calcaratus* than to the *C. decodon*, but differs from it in the more numerous ventral scales, keeled preanals, less numerous femoral pores, etc. From Moyabamba, Peru.

10. *DICRODON CALLISCCELIS*, Cope, sp. nov.

The inner cusp of each tooth smaller than the outer. Nostril in the internasal plate close to the posterior and inferior suture. Scales of the belly large, transverse, smooth, in eight rows; those of the back commencing as granulations on the interscapular region, and gradually increasing in size until they are similar in size to the large ones which cover the tail in whorls. Like the latter they are keeled, the keels forming continuous lines. There are thirteen series at the groin, and eighteen one-third the length behind the axillæ. Nuchal scales and those of the sides of the neck and body granular. Posterior face of humerus, postero-superior faces of cubitus, superior and posterior faces of femur, and superior face of tibia granular; other faces of limbs scutate. Femoral pores eighteen on each side. Anal scuta in three longitudinal series of alternating rhombic plates. Margin of neck fold granular; its middle with five transverse rows of unequal transverse scales.

Internasals and prefrontals in extensive contact; the frontonasal hexagonal, longer than broad. Frontal narrow behind, angulate in front, divided transversely by a suture at the penultimate supraorbital scute. Frontoparietals very small,

separated by the small interparietal which is in contact with the frontal. Two small suboval parietals on each side, and ten or twelve large scales surrounding them behind. Loreal elongate; labials 5-5. Four supraorbitals, the last two separated from the frontal by granules. Six large infralabials, the last three smaller and separated by two plates from the labials; the anterior pair in contact. Gular scales small, smooth, a wide band of smaller scales separating them from those of the collar.

	M.
Total length . . . . .	.343
Length to vent . . . . .	.099
“ to axilla . . . . .	.040
“ to ear . . . . .	.022
“ to orbit . . . . .	.011
Width of head behind . . . . .	.014
Length of hind limb . . . . .	.073
“ of hind foot . . . . .	.037

Color olive above, becoming yellow posteriorly and on the tail; below yellowish-olive. A dark line bounding the dorsal scales on the side, and a row of small blackish spots along the middle of the granular lateral band. Femur yellow behind, with two parallel black bands. Tail with light bluish spots on the sides. Head, back, and belly unicolor.

This fine and very distinct species was brought by Prof. Orton from Pacasmayo, on the Pacific coast of northern Peru.

11. *CNEMIDOPHORUS LEMNISCATUS*, Daudin. Duméril, Bibron, V. p. 128.

From the Marañon and the Amazonas at Santarem.

12. *CNEMIDOPHORUS ARMATULUS*, sp. nov.

Tongue not furcate behind, but not received into a sheath as in *Amiva*. Abdominal scales smooth in eight longitudinal rows; preanal scuta in three rows of two each, followed by two small round scuta in longitudinal line, surrounded by small scales except in front. On each side of these a group of five spur-shaped scales, with projecting acute apices, in two rows, of which the posterior includes three. Gular fold bordered with small scales, which are preceded by two cross-rows of large scutella. Gular region with a few median scutella of the same size which graduate into those surrounding.

Head rather elongate, frontal not divided; frontoparietals distinct, longer than wide. Three supraorbitals, the anterior partly isolated. Parietals and interparietals each longer than wide, surrounded on the sides and behind by one series

of flat scales much larger than those of the nape. The latter, with those of the back and sides, subequal, flat, subhexagonal, and of small size. Scuta of front and back of humerus continuous with each other, and nearly so with those of cubitus, which form two rows, the posterior very wide. Femoral pores twelve. The fore foot reaches the nostril; the posterior, the middle of the tympanum.

Color bright olive-green, with yellow muzzle, and a pale dorsal band. There are three pale lines on the side, from the orbit, ear, and axilla respectively, of which the middle one is interrupted and separated from the superior by an irregular black band. Below white, sides blue. Length from end of muzzle to vent, m. .048.

From the valley of Jequetepeque, Peru.

This species resembles the *Amiva hedracantha*, Boc., Miss. Scient. Mexique, p. 263, in its preanal spines and other respects. According to M. Bocourt that species has but one frontoparietal shield, which is of unusually short proportions, thus resembling the genus *Verticaria*, Cope. It also differs from the *C. armatulus* in the presence of two preoculars (one in *C. armatulus*), and in having a single large median preanal plate.

13. *AMIVA SURINAMENSIS*, Gray, Dum. Bibr. Erp. Gen., V. p. 100.

Rioja and Nauta, Peru; Mara  n, and Santarem.

IGUANIA.

14. *SCYTOMYCTERUS LEVIS*, Cope, gen. et sp. nov. Anolidarum.

Char. Gen.—General structure as in *Anolis*, the posterior teeth with three cusps, the median larger. Rostral plate produced into a flexible appendage.

This form approaches nearest to the *Anolis gracilis*, in which the end of the muzzle is slightly protuberant, but is not prolonged into a process. This species has been erected into a genus by Dr. Gray under the name of *Rhinosaurus*, without, as it appears to me, sufficient reason. The name is also preoccupied.

Char. Specif.—Scales of the body smooth, of nearly equal size; those of the tail larger, the median superior series not different from the others. Scales of the head large and smooth, only three rows between those of the canthus rostralis at the middle. The latter are unusually wide, and the median row larger than those on each side of it. The latter are continued posteriorly into the superciliary rows, which are large, and in contact along the entire middle line. The middle row of the muzzle is replaced by two rows in the shallow frontal concavity. There are four rows between the nostrils. The occipital is large, in contact with superciliary shields in front, and with flat scales behind. One row of loreal scales,

except at the orbit, where there are two. Postocular and temporal scales equal to or larger than the dorsal. A series of large infralabials in contact with the labials throughout. Auricle half the size of the eye-slit. The legs are short; the fore foot only reaching to the front of the orbit, and the hind limb falling considerably short of the axilla. Toe expansions rather narrow. Lateral occipital crests prominent.

Color above dark gray, below pigmented white (in spirits). The two colors are abruptly defined between the orbit and the scapula, and there are brown spots behind the axilla. Tail distantly annulate.

	M.
Total length . . . . .	.139
Length to vent . . . . .	.060
" to axilla . . . . .	.027
" to meatus . . . . .	.017
" to orbit . . . . .	.009
Width of head behind . . . . .	.009
Length of fore limb . . . . .	.018
" of hind " . . . . .	.027
" of hind foot . . . . .	.012
" of tibia . . . . .	.007

From between Moyabamba and Balsa Puerto, on the river Huallaga in Eastern Peru.

Besides its generic characters, this species has larger head scales than the *A. gracilis*, where the superciliaries are separated by two series. The legs are shorter.

15. *ANOLIS TRANSVERSALIS*, Duméril, Archives du Museum, 1856, p. 515.

From Nauta.

Mr. O'Shaughnessy has recently (Annals Magaz. Nat. Hist. 1875) regarded the *A. impetigosus*, Cope, as identical with the present species. I think that it will be found on examination of the type specimen now in the British Museum, to differ from the *A. transversalis* in its larger abdominal scales, larger and fewer supraorbitals, less numerous large inferior caudals, and strikingly in the coloration.

A few other determinations of Mr. O'Shaughnessy's paper will require revision. Thus the specimen in the British Museum labelled *Chamaeleolis porcus* is not the species described by me under that name; the only specimen of it known to me, is in the museum of the Philadelphia Academy. *Anolis argenteolus* and *A. lucius* are distinct. The *A. chlorocyaneus*, of Dum. Bibr., includes two species, as their description indicates, and as I discovered by an examination of the type

specimens in the museum of the Jardin des Plantes. One of these is the *A. caelestinus*, Cope; for the other the name *A. chlorocyaneus* must be retained. Both *A. pentapryon* and *A. vittigerus* are abundantly distinct from the familiar *A. biporcatus* of Mexico; and *A. bitectus* and *A. ordinatus* are, I think, outside the range of variation of the species to which Mr. O'Shaughnessy refers them, though nearly allied. *Anolis spectrum*, Pet., is distinct from *A. cyanopleurus*, Cope.

16. *ANOLIS ORTONII*, Cope, Proceed. Acad. Philada. 1868, p. 97.

From Nauta. One of the specimens is brilliant golden, with green reflections.

17. *ANOLIS BOCOURTHII*, Cope, sp. nov.

Allied to the preceding, and to the *A. trochilus* and *A. bransfordii*, Cope. The abdominal scales are small, flat, and smooth; the dorsals are smaller and thickened, but not keeled, and the laterals are a little smaller still, and subgranular. They graduate into the dorsals and ventrals. The tail is slightly compressed, but has no median keel. The head is elongate, exceeding the length of the tibia; the muzzle is longer than it is wide at the anterior margin of the orbits. Occipital scute small, a little exceeding the auricular meatus, and separated from the superciliaries by numerous flat scales. The superciliary scales separated by two or three rows of small scales. The facial rugæ are very obtuse, and are separated by a shallow concavity. The latter is floored with smooth scales, which are much smaller than those of the rugæ, a transverse line crossing eight of them. The scales of the front of the muzzle are larger, and twelve rows without keels may be counted between the canthal series. Supraorbitals few, surrounded by granules; consisting of one hexagonal smooth plate, surrounded, except on the inner side, by five similar or smaller ones. Seven loreal rows; labials 8-9; infralabials subequal, small, smooth, and in four rows. Auricular meatus half the size of the eye-slit. Fan large. The fore limb reaches the end of the muzzle, but the hind limb only reaches the front of the orbit.

	M.
Total length . . . . .	.1350
Length to vent . . . . .	.0450
“ to axilla . . . . .	.0200
“ to ear . . . . .	.0110
“ to orbit . . . . .	.0055
Width of head behind . . . . .	.0060
Length of hind limb . . . . .	.0335
“ of hind foot . . . . .	.0145

Coppery-brown above; below, light coppery, frequently dusted and speckled with brown, especially in females.

As compared with *A. bransfordii* and other allies, the *A. bocourti* has a longer head, fewer and smooth supraorbital scales, and shorter hind legs. It is abundant at Nauta. I dedicate it to Dr. Bocourt of Paris, whose magnificent work on the Reptiles of Mexico has added much to our knowledge of the *Anolidæ*.

18. *ANOLIS TRACHYDERMA*, Cope, sp. nov.

Abdominal scales small, obtusely keeled; three or four median dorsal series, nearly as large as the ventrals, flat, keeled, and quickly graduating into the granular scales of the sides. These, with the scales of neck, throat, and sides of the head, are angulate or subround so as to produce a shagreened surface. Tail round, curved with flat keeled scales. Occipital oval, small, nearly equal to ear, separated by two rows of elongate keeled scales. Facial rugæ obsolete, the scales on its usual position and external to it, larger than those that occupy the frontal concavity, which are narrow, keeled, and in five or six rows, arranged (in the only specimen) concentrically posterior to a median scale. Twelve rows at the middle of the muzzle, all flat and carinate. Supraorbitals keeled, arranged in a circle round two central scales, ten altogether. Six rows at middle of lores. Auricular meatus one-third of eye. Labials 9-11; infralabials not distinct from gulars, keeled.

Head oval, as long as tibia; muzzle longer than wide at front of orbits. The fore limb reaches the end of the muzzle, but the hind limb only extends to the middle of the orbits. Fan large.

Color black, above and below, excepting thorax, abdomen, and inferior middle line of tail, which are fulvous. An indistinct light band across the chin, half way between eye and nostril.

	M.
Length of head and body . . . . .	.055
“ to axilla . . . . .	.027
“ to ear . . . . .	.019
“ to orbit . . . . .	.006
Width of head behind . . . . .	.008
Length of hind limb . . . . .	.045
“ of hind foot . . . . .	.018

One female specimen from Nauta.

19. *ANOLIS BOMBICEPS*, Cope, sp. nov.

Abdominal scales keeled; dorsals much smaller, smooth, and a little larger than the almost granular laterals. Tail subround, with equal scales. The head

is short, wide, and convex above, with very large orbits. Its length to ear is less than that of the tibia, and the length of the muzzle less than the width at the front of the orbits. Occipital scute subround, larger than tympanum, surrounded by numerous smaller smooth scales. Superciliaries separated by two rows of small scuta. Rugæ distinct, low, inclosing a concavity containing smaller scales than the rugal, in four longitudinal rows. Ten rows crossed by a section of the muzzle at the middle. Supraorbitals seventeen or eighteen, smooth or nearly so. Loreals six rows; infralabials scarcely distinct, keeled. Meatus round, equal half diameter of eye-slit. Fan small. The hind limb reaches beyond the front of the orbit, and the fore limb to beyond the end of the muzzle.

	M.
Total length . . . . .	.1300
Length to vent . . . . .	.0460
“ to axilla . . . . .	.0230
“ to ear . . . . .	.0118
“ to orbit . . . . .	.0040
Width of head at jaws . . . . .	.0065
Length of hind limb . . . . .	.0400
“ of hind foot . . . . .	.0170

General color bright olive, shaded with brown above. A dark band from ear to shoulder, and vertical blackish bars on the sides. Fan dark ?indigo. A longitudinal black band on the former behind. A white spot on each side of the lower jaw in three specimens.

Four specimens from Nauta.

This species is near the *A. trachydermus* and *A. lemurinus*, Cope. From the former, the very different form of head, the distinct rugal scales of the front, inclosing larger and smoother scales, with the small smooth dorsal scales distinguish it. The *A. lemurinus* resembles it in form, but has larger dorsal scales.

20. *NOROPS DUODECIMSTRIATUS*, Berthold; *N. macrodactylus*, Hallow.

Two specimens from Santarem, Brazil.

21. *IGUANA TUBERCULATA*, Laur.

22. *ENYALIUS LATICEPS*, Guichenot in Castlenau's Anim. Nouv. ou rare Amer. Sud, pl.

23. *ENYALIUS COERULESCENS*, Cope, sp. nov.

A dentellated nuchal crest, a vertebral band of linear scales; no caudal crest; all subround in section. Head wide, the muzzle parabolic, its entire surface including the supraorbital region covered with equal, acutely tubercular scales. Three

rows intervene between the superciliary rows; occipital scarcely distinct. Nostril pierced in a small round shield; nearer orbit than end of muzzle. Loreal region very short, with ten scales on a vertical line. Supraocular scales eighteen, counting to nostril. Labials 11-11, a short series of distinct, smooth infralabials. Auricular opening large. Dorsal scales very small, keeled, in transverse rows; abdominal scales larger, in cross series, interrupted on the middle line, keeled. The hind leg and wrist extend to front of orbit.

Color black, with numerous indistinct blue cross bands. Limbs, especially the forearm, and the sides of the neck, dark blue. Lower surfaces white, except throat and chin, which are blackish-blue.

	M.
Total length . . . . .	.185
Length to vent . . . . .	.072
“ to axilla . . . . .	.034
“ to ear . . . . .	.018
“ to orbit . . . . .	.006

Width at anterior angle of orbit .009; apparently allied to the *E. brasiliensis*, Lesson (Voyage Coquille Reptiles, Pl. I., fig. 3), but that species has a dorsal crest of erect scales.

24. *HYPERANODON OCHROCOLLARIS*, Spix, Dum. Bibr. Erpet. Gen., V.

25. *HYPERANODON PELTIGERUS*, Cope, sp. nov.

Scales of belly, sides, and back of about equal size, the former keeled, those of sides and back without median keel, but with a strong mucro (the epidermis is lost). A crest of processes on the nape which extend on the back to its middle only as a row of keeled scales. Top of head covered with large scales; the occipital broader than long, bounded behind by small scales and at the middle on each side by a small oval parietal. Three scales on the front between the canthus rostrales, the outer ones the front of the superciliary series, which are partially united between the orbits. Six scales across the front behind the nostrils. Supra-orbitals in a single row of four transverse scales, which are bounded by a series of small ones on the inner border, and from one to two rows on the outer margin. Rostral narrow, horizontal; four upper, five lower labials. Symphyseal deeper than wide, truncate behind; one anterior infralabial larger than the rest, smooth. Scales of the limbs smooth, except a few with obsolete keels on the upper side of the humerus and of the femur. Cervical dermal fold strong, extending to a point above the humerus. Tympanum large; nostril in a single plate, which is separated from the rostral and superior labial by a single row of scales. When the

limbs are extended, the wrist reaches nearly to the end of the muzzle, and the longer toe to the posterior border of the orbits.

Color dark yellowish-brown above, light brown below. Nine dark cross bands on back between scapulæ and rump. A black spot in front of the scapula, with a pale shade above it. Head plates brown, with blue reflections. Tail annulate with brown.

	M.
Total length . . . . .	.275
Length to vent . . . . .	.087
“ to axilla . . . . .	.037
“ to orbit . . . . .	.008
Width of head behind . . . . .	.019
Length of hind limb . . . . .	.067
“ of hind foot . . . . .	.028

This species differs materially from the last in its larger head-scuta, especially the supraorbitals, and smooth abdominal scales.

26. *DORYPHORUS FLAVICEPS*, Guichenot in Castlenau's Voyage in Amér. Meridionale.

27. *HYPHIBATES AGAMOIDES*, Wiegmann, Dum. Bibr.

From Moyabamba, Peru.

28. *MICROLOPHUS HETEROLEPIS*, Wiegmann; *Tropidurus heterolepis*, Wiegmann. Nova Acta Caes. Leopold. Nat. Cur., xvii. p. 223, tab. 16.

Scales granular, a series forming a low crest from the nape to the end of the tail. No femoral nor anal pores. Tail compressed. Head with a broad interparietal shield, and large supraorbitals. Ear distinct; nostril above canthus rostralis. Two prehumeral folds, which nearly meet in the middle.

Abdominal scales much larger than the others, smooth, in transverse rows; those of the tail of equal size, half keeled. Nine smooth scales in a line across the middle of the muzzle. Nostrils subvertical in one plate, which is separated from the rostral by one scale, from its mate and from the labials by two scales. Superciliary rows in contact; interparietal broader than long. Five transverse smooth supraorbital scuta bordered within by one, and without by two rows of small scales, with a few of intermediate size between them and the latter. One very long suborbital; eyelids fringed with narrowly conic scales. Four loreal rows. Labial scales 7-7 to the coronoid elevation of the lower jaw, very narrow; the rostral broad, angulate above. Three large smooth infralabials separated from the inferior labials by small scales. Some weak dermal folds on the side of the

neck, and two similar to them along each side. A strong vertical fold in front of each shoulder.

	M.
Total length (tail reproduced at end) . . . . .	.175
Length to vent . . . . .	.070
“ to axilla . . . . .	.032
“ to meatus of ear . . . . .	.015
Width of head behind . . . . .	.013
Length of hind limb . . . . .	.047
“ of hind foot . . . . .	.021

The ear is partially closed in front by a narrow flap of skin, which supports several flat, acuminate, dermal denticles, of which two are most prominent. The limbs are rather short, the fore limb reaching the end of the muzzle, the hind limb not quite reaching the ear.

Color above light grayish-brown, with about eleven transverse series of small brown spots. Back also with distant yellow speckles; head light and dark brown speckled. Under surfaces yellowish-white, except the thoracic amfugular regions, which are black.

29. MICROLOPHUS INGUINALIS, sp. nov.; *Microlophus lessonii*, Var. Dum. Bibron, Erp. Gen., iv. p. 341.

Dorsal scales small, flat, a median larger row, scarcely elevated on the nape and tail, flat on the back. Two lateral folds from tympanum to groin; a prehumeral fold nearly meeting its mate on the thorax; a series of four or five denticulations in front of the ear. Parietal shield large, broader than long, Two rows of frontals (superciliaries), which unite on top of the muzzle in a circular rosette of seven smooth shields inclosing a small one in the centre. Four rows of scales between the nasal plates. One row of large, and one or two rows of small loreal scales. Four or five rows of infralabials, the gulars abruptly distinguished from them, and considerably smaller. The end of the external digit of the fore limb reaches the end of the muzzle, and the longest hinder toe reaches the nostril.

	M.
Length (tail entire) . . . . .	.151
“ to vent . . . . .	.057
“ to axilla . . . . .	.025
“ to ear . . . . .	.013
“ to orbit . . . . .	.005
Width of the head behind . . . . .	.011

Emerald-green above, white below; a lateral black band which incloses at the groin a large longitudinal yellow spot. Limbs faintly yellow spotted. Throat with blue chevrons from the lips.

This species agrees with the *M. heterolepis* in many respects, although very distinct in coloration. It differs in squamation in the fewer loreals and more numerous muzzle scales. In *M. heterolepis*, the gular scales are scarcely smaller than the labials, and graduate regularly into them.

Valley of Jequetepeque, Peru.

30. *MICROLOPHUS PERUVIANUS*, Less.; *M. lessonii*, Dum. Bibr.

In this species there are four rows of scales between the nasal scales, and the infralabials and gulars are distinguished abruptly. It differs from the other species here described in the form of the parietal, which is longer than broad, as represented by Lesson (Voyage of the Coquille).

31. *CRANIOPELTIS OCCIPITALIS*, Bocourt; *Aneuporus occipitalis*, Bocourt; Mission Scientifique de Mexique, p. 215.

One specimen from Jequetepeque differs in coloration from that described by M. Bocourt, but not otherwise. It has a broad, brown dorsal band, which is crossed at rather remote intervals by deep brown, narrow cross-bars. Lower surfaces uniform white. *Aneuporus*, Boc., must yield to the prior *Craniopeltis*, Pet.

32. *PROCTOTRETUS MULTIFORMIS*, Cope, sp. nov.

Nostrils entirely above the canthus rostralis, laterosuperior in direction. External meatus of ear much larger than eye opening, its anterior border simple. Frontal plate subdivided, the middle portion not divided lengthwise. Three flat scales on front between canthus rostrales; interparietal small, in contact with superciliaries, and two occipitals of equal size behind it. Four entire, and one divided transverse supraorbitals. Labials $\frac{8}{6}$; four or five large infralabials, separated from labials by one row of scales in front and two behind. An irregular dermal fold extending posterior to the ear. Scales of side of neck, and scapular and axillary regions, granular. Those of back and sides of body rather small, flat, the dorsals weakly keeled, with smooth ones intermixed, the laterals nicked. Those of the lower surfaces a little larger, not notched. Scales of femur behind, small, flat, of lower side of humerus, granular; other scales of limbs like the dorsal, on the tibia, keeled. The fore foot reaches the nostril, and the hind foot the axilla. The dimensions of the largest specimen (var. 1) are as follows:—

	M.
Total length . . . . .	.190
Length to vent . . . . .	.093
“ to axilla . . . . .	.039
“ to ear . . . . .	.023
“ to orbit . . . . .	.008
“ of hind limb . . . . .	.052
“ of hind foot . . . . .	.023
Width of head behind . . . . .	.021

This species varies considerably in coloration, presenting the following varieties:—

I. Bright green, paler posteriorly, with two rows of large transverse black bars with irregular edges. Head brown above, pale speckled, lower surfaces olive. One specimen.

II. Olive-brown above, with faint darker cross-bands, pale bordered behind; sides and below blue to whitish; three specimens.

III. Light brown with a row of black spots on each side, divided by a longitudinal pale band. Below yellowish, marbled with bluish; one specimen.

All the specimens are from the elevated Lake of Titicaca, Peru.

NYCTISAURA.

33. *PHYLLODACTYLUS INÆQUALIS*, Cope, sp. nov.

Scales of back and sides subequal, the former of unequal sizes, but without elevated or keeled tubercles. Ventral scales larger, subround, smooth; those bordering the vent in front smaller. Muzzle with convex scales larger than those on the occiput. Labials to below the pupil, six above; below five, followed by three others; the inferior first three are the larger. Mental scutum longer than wide, angulate behind, with an oval scute on each side of the angle, which meet by an angle each on the middle line. Behind these are round scales from which others graduate into the granules of the throat. Meatus auditorius a very small slit. Eye contained nearly twice in length of muzzle. The fore limbs extended reach the front of the orbit; the hind limbs extend to the appressed elbow. Scales of the normal tail square, and flat above; rounded and a little larger below.

Above yellowish, with seven blackish cross-bands from nape to groin, somewhat connected by oblique and longitudinal lines on the sides. A dark band from nostril through eye to shoulder. Limbs and tail cross-banded. Head with a

coarse, blackish reticulation above. A brown spot on each labial. Below straw-color, immaculate.

	M.
Length to vent . . . . .	.0380
" to axilla . . . . .	.0180
" to ear . . . . .	.0100
" to orbit . . . . .	.0045
" of hind limb . . . . .	.0070
" of hind foot . . . . .	.0170
Width of head behind . . . . .	.0060

This species belongs to the section called by Gray *Diplodactylus*. From Pacasmayo.

34. *PHYLLODACTYLUS MICROPHYLLUS*, sp. nov.

Small scales of the back and sides with larger ones scattered irregularly among them; these are not very much larger, not keeled, but smoothly convex, and a little smaller than the smooth, flat belly scales. Gular scales granular; labials to pupil $\frac{7}{8}$. Mental large, convex behind, bounded by four round scales of small size. Scales of top of muzzle twice as large as those of vertex. Tail scales uniform. Transverse scales of inferior side of the digits rather short; large plates of the end of the toes remarkably small, permitting the ungual phalange to project very freely. A row of prominent scales behind the thighs on each side of the base of the tail. Color very pale, with a few very indistinct transverse shades; in the young these shades are cross-bars.

	M.
Total length . . . . .	.101
Length to vent . . . . .	.048
" to axilla . . . . .	.022
" to ear . . . . .	.012
" to eye . . . . .	.005
Width of the head behind . . . . .	.010
Length of hind limb . . . . .	.020
" of hind foot . . . . .	.008

From the valley of Jequetepeque, Peru.

This species is intermediate between the last described, *P. inæqualis*, and such species as the *P. reissii* in the character of the squamation. In the small size of its distal laminae of the digits, it differs from all the other species, and approaches the Australian genus *Stenodactylopsis* of Steindachner.

35. *PHYLLODACTYLUS REISSII*, Peters, Monatsber. Berlin Academy, 1862, p. 626.

From the valley of Jequetepeque.

36. *THECADACTYLUS RAPICAUDA*, Houttyn.

37. *GONIODACTYLUS*.

AMPHISBÆNIA.

38. *AMPHISBÆNA OCCIDENTALIS*, Cope, sp. nov.

Nasal, frontonasal, and parietal scuta in mutual contact in pairs, the last pair forming a half disk. Nasal not reaching lip; rostral protuberant, little visible from above, triangular in outline. Labials four above, three below; first superior longer than high, second higher than long, fourth very small. First labial twice as deep as long, second largest, longer than deep. Symphyseal narrowed and truncate behind, and bordered by a longitudinally oval plate, which also bounds the first and second labials below. A crescentic row of seven scuta bound the posterior borders of this and the labials, the median being the smallest. Ocular plate small, subquadrate, followed by four scales bordering each parietal to the median suture. Preanal scuta six, pores four, caudal annuli nineteen. Eye invisible.

Above, numerous scales dark-lead colored, interrupted by colorless ones. Below, white.

	M.
Total length . . . . .	.285
Length to rictus oris . . . . .	.006
“ of tail . . . . .	.023

Common in the valley of Jequetepeque. Allied to the *A. vermicularis* and *A. darwini* of Duméril and Bibron. The former differs, among other points, in the possession of eight temporal scuta on each side; the latter has occipital scales, and only three superior labials.

39. *AMPHISBÆNA FULIGINOSA*, Linn.

OPHIDIA.

SCOLECOPHIDIA.

40. *TYPHLOPS RETICULATUS*, Linn.

From the Marañon.

TORTRICINA.

41. *TORTRIX SCYTALE*, Linn.

From the Marañon and Solimoens.

ASINEA.

42. *EUNECTES MURINUS*, L.
From the Amazon.
43. *BOA CONSTRICTOR*, L.
From the Solimoens.
44. *XIPHOSOMA HORTULANUM*, Lin.
From Iquitos on the upper Marañon.
45. *LEPTOGNATHUS CATESBYI*, Wieg.
From Rioja, Peru, the Marañon, Iquitos upper Marañon.
46. *RHINOBOOTHRYUM LENTIGINOSUM*, Scopoli.
47. *DIPSAS CENCHOA*, L.
Iquitos.
48. *SIBON ANNULATUM*, L.
From the Solimoens.
49. *GERRHOSTEUS PROSOPIS*, Cope, Proceed. Acad. Philada. 1874, p. 71.
From Nauta, Peru.
50. *SCYTALE CORONATUM*, Linn.
51. *OXYRRHOPUS FITZINGERII*, Tschudi, Fauna Peruana Reptiles, p. 56.
Valley of Jequetepeque.
52. *OXYRRHOPUS PETOLARIUS*. Subsp. *PETOLARIUS*, L.
53. *DRYOPHIS ARGENTEA*, Daud.
54. *LEPTOPHIS MARGINATUS*, Cope; *Thrasops marginatus*, Cope, Proceed. Academy Philada. 1862, p. 349; *Ahætulla nigromarginata*, Günther, Ann. Magazine Nat. History, 1866.
55. *LEPTOPHIS ORTONII*, Cope, sp. nov.

Scales smooth, in fifteen series. Head rather short, muzzle equal or shorter than width between eyes. No loreal plate; postnasal about as large as prenasal plate; preoculars scarcely reaching frontal. Two postoculars. Temporals large, 1-2, followed by smaller scales. Superior labials nine, fifth, and sixth only bounding orbit. Seven lower labials in contact with geneials. Tail very long, two-fifths of the total. Gastrosteges not angulate, three times as wide as long.

	M.									
Total length (No. 1)965
Length of tail (No. 1)390
Total length (No. 2)950
Length of tail (No. 2)400

Color above blue, a coppery golden spot within the apex of many of the scales, which extends on those of the external two rows, so as to cover the scale except at its base. Gastrosteges coppery-golden, the front margin sea-green. The blue scales have a black tip, and often a narrow border; the head is uniform green, except the yellow lips and a narrow black line along the upper margin of the posterior labials.

This splendid species is nearly allied to the *T. marginatus*, Cope, having the same short head and nasal scuta. It differs in its smooth scales, and in the coloration, for in that species the golden is entirely wanting, and the head scuta as well as the scales are broadly black bordered. The *T. marginatus* in addition has the gastrosteges strongly angulate and recurved on the sides, and only twice as wide as long.

Of my two specimens of *T. marginatus*, one has eight superior labials, as in the type, the other nine, on both sides. Their measurements are as follows:—

	M.
Total length (No. 1)	1.190
Length of tail (No. 2)	.460
Total length (No. 1)	1.155
Length of tail (No. 2)	.450

The *Leptophis ortonii* was discovered by Professor James Orton on the Solimoes or middle Amazon, and I take great pleasure in dedicating it to him as a token of esteem.

56. *PHILODRYAS VIRIDISSIMUS*, Linn.

From between Moyabamba and Balsa Puerto, Peru.

57. *HERPETODRYAS HOLOCHLORUS*, Cope, sp. nov.

Scales in ten longitudinal series, all wide, especially those of the first, which are as deep as long. The scales of the two vertebral rows are also wide, and all are smooth. The head is of normal form and size, with vertical lores, and eyes of moderate size. The rostral is as broad as high, the loreal a very little longer than high, and the preocular not reaching the frontal. Two postoculars, temporals 1-1; three scales only bordering the two parietals, whose posterior outline is strongly notched. The common suture of the parietals is shorter than the frontal and the superciliary. The frontal is narrowed behind, and the width in front less than the lateral sutures. Labials nine above, all rather low, fifth and sixth, and sometimes a corner of the fourth, entering the orbit; eleven inferior labials, of which seven are in contact with the geneials.

	M.
Total length (No. 1) . . . . .	.680
Length of tail (No. 1) . . . . .	.220
Total length (No. 2) . . . . .	.685
Length of tail (No. 2) . . . . .	.220

Anal plate entire in five specimens.

Color uniform green, pale on the lips and throat. In a young specimen (.340 m.) there are slightly black edged scales in small patches on each side of a pale vertebral band.

As compared with the *H. fuscus*, this species has a smaller eye at all ages, and a stouter form, including shorter tail. It bears the same relation to the form called *Dendrophis viridis*, by Duméril and Bibron.

From the Marañon. (No. 39.)

58. *HERPETODRYAS CARINATUS*, Linn.

From the lower Amazon.

59. *HERPETODRYAS FUSCUS*, Linn.

Two from Iquitos; one from the Solimoens, etc.

60. *DRYMOBIUS HEATHII*, sp. nov.

Scales elongate, biporous, smooth, in seventeen longitudinal rows. Form slender, head narrow; the frontal shield with concave sides, much narrower behind than before, and one-fourth longer than the muzzle anterior to it. Parietals long. Postnasal higher and shorter than prenasal. Loreal long and low, lowest behind. One preocular not reaching frontal, two postoculars; temporals 2-2, long and narrow. Superior labials nine, fourth, fifth, and sixth, entering orbit; inferior labials ten, six in contact with geneials. Pregenials only half as long as postgenials. Gastrosteges 188; anal divided; urosteges 116. Muzzle shorter than interorbital, width by nearly the diameter of the eye.

General color olivaceous-ashen; a broad, brown, dorsal band, which is darker edged, extends to the tail, involving five rows of scales. A brown band on each side involves the first, second, and third rows of scales, which are blackish tipped. Lips and below lighter, unspotted; a dark band from nostril through eye to last labial shield.

	M.
Total length . . . . .	.780
Length of tail . . . . .	.240
“ to rictus oris . . . . .	.019

This whip-snake is allied to the *Drymobius boddærtii*, especially to the pale-banded variety. It is a more slender species, with narrower head plates, especially the frontal and loreal.

Obtained in the valley of Jequetepeque, Peru, by Doctor Edwin R. Heath, to whom I take great pleasure in dedicating the species, as a testimony to his disinterested zeal in advancing natural history.

61. *DRYMOBIUS BODDÆRTII*, Seetz.

From the lower Amazon.

62. *SPILOTES PICEUS*, Cope, Proceedings Academy Philada. 1868, 105.

From the Marañon. Adult and young, the latter with narrow white cross-bands, as in the species of *Drymobius*.

63. *SPILOTES PULLATUS*, Linn.

64. *XENODON COLUBRINUS*, Gthr., Catalogue B. M. p. 55.

65. *TACHYMENIS CHILENSIS*, Schleg. Günther, Catal. p. 34.

From Lake Titicaca.

66. *OPHEOMORPHUS MERREMMII*, Wied.

67. *LYGOPHIS PÆCILOSTOMUS*, sp. nov.

Scales in nineteen rows, poreless; anal plate divided, dentition diacranterian. Frontal shield with concave sides, nearly as wide behind as before, twice as long as wide, its length one-half greater than that of the muzzle in front of it. Rostral little visible from above; postnasal higher than prenasal; loreal oblique, higher than long. Oculars 1-2, the preocular scarcely reaching frontal; temporals 1-2. Superior labials eight (nine on one side), fourth and fifth in orbit. Inferior labials nine, six in contact with geneials. Postgeneials the longer. Gastrosteges 206; urosteges 89.

Color above ashen-brown, with a series of short, dark, brown cross-bands, extending across seven or eight scales, and separated by two rows of scales. These break and alternate on the middle of the length, and then form a serrate band, which is on the tail a uniform longitudinal band. Lips and chin spotted with brown; belly ashey.

Valley of Jequetepeque.

This snake is somewhat like the *Liophis chamissonis*, but belongs to another genus.

68. *LIOPHIS REGINÆ*, Linn.

69. *LIOPHIS ALMADENSIS*, Wagler.

From the Solimoens.

70. LIOPHIS TEMMINCKII, Schleg.; *Tæniophis tantillus*, Girard.

71. LIOPHIS PYGMÆUS, Cope, Proceed. Academy Phila. 1868, p. 103.

72. TANTILLA CAPISTRATA, sp. nov.

Ocular plates 1-1; labials seven above, the seventh the largest, the third and fourth bounding the orbit. The postnasal smaller than the prenasal, well separated from the short preocular by the prefrontal, which touches the second labial. Rostral not very prominent; frontal wide, much shorter than the large parietals. Temporals 1-1, long and narrow. First pair of inferior labials in contact, postgenaeals short. Scales of body in fifteen series. Gastrosteges 139; anal divided; urosteges 71.

All the scales above the second row are brown-bordered; below this row white. Head above black, except the muzzle, which is white to the line of the preocular plate; a large labial spot behind the eye, and the hinder border of the parietals. A black half collar connected with the black crown by a longitudinal bar.

Total length .136; of tail .035; to rictus oris .005.

Valley of Jequetepeque, Peru.

73. TANTILLA MELANOCEPHALA, Schl.

74. HELICOPS POLYLEPIS, Gthr., Ann. Magaz. Nat. Hist.

The Solimoens.

75. HELICOPS ANGULATUS, Linn.

From Iquitos on the Marañon.

76. RHABDOSOMA PÆPPIGII, Jan. Arch., p. Zoologia Modena II. 1862, 11.

77. RHABDOSOMA BADIUM, Dum. Bibr.

From the Solimoens. Several color varieties.

PROTEROGLYPHA.

78. ELAPS NARDUCCII, Jan.

79. ELAPS IMPERATOR, Cope, Proceed. Academy Philada. 1868, p. 110.

A strongly marked subspecies, characterized by the continuation of the black rings entirely round the body, and of the black color which replaces the red rings to the gastrosteges. Also by the almost entire black color of the head, and the dusky shade of the lighter parts of the lower surfaces.

From the Solimoens.

80. *ELAPS CIRCINALIS*, Dum. Bibron.

Four specimens from the valley of Jequetepeque. Of these, one has thirty-one black rings on the body; two have twenty-nine, and one has twenty-eight. All have the head black as far as the end of the parietals; the temporal scuta being included in the yellow neck band. Of five specimens from Eastern Costa Rica brought by Mr. Gabb, two have a similar coloration of the head, and in three the yellow collar crosses the occipitals. One has twenty-two black rings on the body, two have thirteen, and two eleven.

81. *ELAPS TSCHUDII*, Jan. Revue et Magazine de Zoologie 1859; Prodrome d'un Iconographie, etc., p. 13.

Numerous specimens from the valley of Jequetepeque are very constant in coloration. One of the most beautiful *Elapes*.

82. *ELAPS ISOZONUS*, Cope, Proceed. Academy Philada. 1860, p. 73-4.83. *ELAPS LEMNISCATUS*, Linn.

Iquitos on the Marañon.

84. *ELAPS SURINAMENSIS*, Cuv.

The scales of the red intervals tipped with black. Two specimens from Iquitos on the Marañon.

SOLENOGLYPHA.

85. *BOTHROPS BRASILIENSIS*, Latreille.

The Marañon near the mouth of the Napo.

86. *BOTHROPS MICROPTHALMUS*, Cope, sp. nov.

The maxillary fossette bounded in front by small scales, and below by two narrow scales. The superior labials number seven, of which the first two are small, and the third the largest, equalling the sixth; the fourth and fifth are shorter, and as high as long. The seventh is as long as the sixth, but lower. The fourth labial immediately under the pupil of the eye, and separated from it by two scales. Large and slightly keeled scales bound the labials above behind the eye. Nasals distinct, each higher than long, separated from the eye by a long preocular and a smaller loreal. Rostral plate rectangular, one-fourth higher than wide at the middle. Muzzle short, canthus rostralis bordered above by two scuta, and a scale next the superciliary plate, the scuta remarkably wide, the posterior pair separated by three large smooth scales on the summit of the muzzle. Superciliary shields three-fifths as wide as long, separated at the middle by two smooth scuta;

behind by five wide smooth scales. Scales of the top of the head smaller, sub-hexagonal, and smooth. Inferior labials ten, all wider than long. Scales of the body not elongate, in twenty-three longitudinal rows, the lower one or two rows smooth, the remainder keeled, but differently from what is observed in other species. Thus the keels do not reach the extremity of the scale, but terminate in an enlargement, which, on the posterior parts of the body, is a prominent tubercle. Gastrosteges 159; anal entire; urosteges 52.

Color above yellowish-brown, anteriorly uniform, and marked on the posterior two-thirds of the body with brown triangles on the sides, whose apices meet or approach on the middle line above. The interior at the base of the triangle is occupied by the ground color, which increases in extent anteriorly, so as to reduce the triangles to skeletons, and then obliterate them. Posteriorly the united triangles form cross-bands, which become united lengthwise on the tail, and finally confluent so as to form a uniform black. Head yellowish-brown above, yellow below, a yellow band extending from the eye to the side of the neck, which is bounded all the way by a brown band below. Belly yellow anteriorly, shaded increasingly with black to the end of the tail, a dark brown spot on the end of every second gastrostege on each side.

	M.
Length . . . . .	.885
Length of tail . . . . .	.125
“ of rictus oris . . . . .	.038
“ to eye . . . . .	.013
Width between eyes . . . . .	.017
Diameter of eye (greatest) . . . . .	.005

From between Balsa Puerto and Moyabamba, Peru.

This pit-viper is evidently a dangerous species, judging from the large size of its venom glands and length of its fangs. Associated with the development of the former, is the very small size of the eye, which is almost closed by the protuberant cheeks. The species is allied to the *B. diporus*, Cope, and *B. neuvidii*, Wagl. It differs, among other respects, in the smooth scales of the vertex, large in front and small behind.

ART. VII.—*Note on the Ichthyology of Lake Titicaca.*

By E. D. COPE.

THE waters of the elevated plateaus of the Andes have been found to be the habitat of several peculiar genera of fishes, mostly belonging to the *Siluridæ* and the *Cyprinodontidæ*. Of the latter family two genera are now known, *Protistius*,* Cope, with one species from the Peruvian Andes, and *Orestias* (Cuvier and Valenciennes), of which six species have been described from the Lake Titicaca in the Bolivian plateau. Prof. James Orton, in his recent exploration of that region, procured specimens of four species of this genus from the Lake. On examination of these I find, unexpectedly to myself, that three of the species are new to science, and accordingly append descriptions of them. They are all in fine condition, and apparently adult.

1. *ORESTIAS PENTLANDII*, Cuv. Val., Vol. XVIII, p. 221.

2. *ORESTIAS BAIRDII*, Cope, sp. nov.

Established on a specimen eight and three-quarter inches long. Radii P. 17; D. 12; A. 16. Scales of the lateral line, counting from the line of the preoperculum, fifty. Scales larger above the operculum and rugose in that region, elsewhere smooth. Operculum about half covered with rugose scales; the lower limb of the preoperculum half as long again as the posterior, the scales small, rugose, and extending its entire length, leaving a naked band below the orbit. A few small, rough scales on the preorbital bone. Preorbital bone subquadrate, as long as high. Mouth directed vertically upwards. Top of the head entirely naked. A band of large rugose scales on the nape, with a naked space on each side of it.

The diameter of the eye is equal to the length of the muzzle, and enters the side of the head five times. The outline of the back and head is continuous and horizontal, the front flat, and over twice the long diameter of the eye. The head enters the length, minus the caudal fin, four and a quarter times, and the depth enters the same four and a half times. The depth of the head enters its length $1\frac{4}{5}$ times. The dorsal fin is further from the anal than the length of its base, and the margin of the caudal fin is openly concave.

This species is evidently nearest to the *O. cuvieri* of Valenciennes; it has a

* Proceedings Academy Philada. 1874, p. 66.

more elongated body and shorter fin bases. The head, according to Günther, is one-third the length in that fish, and the radii are A. 14-16; D. 18-19. It is dedicated to Professor Spencer F. Baird, the assistant secretary of the Smithsonian Institution, the *alma mater* of many naturalists of the present and coming generations.

3. *Orestias ortonii*, Cope, sp. nov.

Radii of the fins, P. 18; D. 16; A. 16. Dorsal outline gently arched to interorbital region, muzzle horizontal, narrowed, the mouth directed vertically upwards. Length of head one-fourth the total, minus the caudal fin, the greatest depth entering the same three and one-third times. Eye four and a half times in the length of the head, and twice in the interorbital width. Lower limb of preopercle three-fourths as long as the posterior. Scales of lateral line, beginning above anterior part of operculum, thirty-two. On the anterior part of the body they are thickened and enlarged, there being but eight rows from the base of superior ray of pectoral fin to the median nuchal row. They extend forwards to between the eyes, and cover the entire operculum, preoperculum, and suborbital bones. All are entirely smooth. The dorsal fin is further from the caudal than the length of its base. Preorbital bone deeper than long.

	M.
Total length . . . . .	.162
Length to basis caudal fin . . . . .	.133
“ to basis anal fin . . . . .	.082
“ to operculum . . . . .	.033
“ to preoperculum . . . . .	.022
“ to orbit . . . . .	.008
Depth of head at orbit . . . . .	.026

Color silvery, the enlarged scales of the anterior part of the body green; head above black, sides yellow.

This species appears to be most nearly allied to the *Orestias owenii*, Cuv. Val., in the proportions of the head to the body, but the head is of a different form. Günther states that the head of *O. owenii* is “nearly three-fourths as long as high;” in *O. ortonii* it is two-thirds as high as long. The caudal peduncle is longer in *O. ortonii*, and the fin-rays of *O. owenii* are stated to be D. 14-5; A. 13-6. In *O. jussieui* the body is shorter by one length of the head, and the radii are D. 14; A. 15.

This species is dedicated to Professor James Orton, of Vassar College, the indefatigable explorer of the Peruvian Andes.

4. *Orestias frontosus*, Cope, sp. nov.

Fin radii D. 14-15; A. 15. Scales of lateral line (commencing above preoperculum), thirty-six. Dorsal region little arched, frontal region protuberant and convex in both longitudinal and transverse section, the profile then descending steeply to the upper lip. Mouth nearly vertical, eye four times in length of head of specimens eight inches long. The depth of the head at the posterior border of the orbits is exactly equal to the length, and its length is contained in the total (without caudal fin), four times in one, and three and three-quarter times in another specimen. The preorbital bone is higher than long, and the inferior border of the preoperculum is two-thirds the length of the posterior. Large, thickened, and smooth scales cover the anterior part of the body, and the operculum, preoperculum, and suborbital bones, and advance on the front to between the orbits. The depth of the body enters the length three and one-third times. Tail even or slightly convex.

	M.
Total length	0.190
Length to basis of anal fin . . . . .	.103
“ of head . . . . .	.038
“ to orbit . . . . .	.010
Interorbital width (axial) . . . . .	.016

This *Orestias* is generally black, the belly having a pale yellowish color.

Its affinities are to the *O. ortonii*, but the difference in the form of the head is very striking. Dr. Günther describes the head of the *O. owenii* as deeper than long, and the posterior border of the preoperculum as equal to the lower, characters not possessed by the *O. frontosus*.

Two specimens were obtained by Prof. Orton, who states that they are called by the inhabitants “Caracha,” while the *O. bairdii* and *O. pentlandii* are known as “Boga,” and adds that all are excellent table fishes.

EXPLANATION OF PLATES.

PLATE I.

Batrachia, natural size.

- Fig. 1. *Cranopsis fastidiosus*; 1a, mouth.
2. *Crepidius epioticus*; 2a, mouth.
3. *Ollotis cœrulescens*; 3a, mouth.
4. *Bufo auritus*.
5. *Bufo coccifer*.
6. *Dendrobates talamancæ*.
7. *Hyla nigripes*.
8. *Phyllobates hylæformis*; 8a, mouth.
9. *Lithodytes podiciferus*.
10. *Lithodytes melanostictus*; 10a, mouth.
11. *Lithodytes megacephalus*; 11a, mouth.
12. *Tryphenteropsis chrysoprasinus*; 12a, mouth.

PLATE II.

- Fig. 1. *Anolis insignis*.
2. " *microtus*.
3. " *pachypus*.
4. " *oxylophus*.
5. *Chalcidolepis metallicus*.

PLATE III.

- Fig. 1. *Basiliscus plumifrons*, natural size; 1a, head from above.
2. *Basiliscus mitratus*; head from above, natural size.

PLATE IV.

- Fig. 1. *Dendrophidium melanotropis*.
2. *Dryophis brevirostris*.
3. *Hyla elæochroa*; 3a, mouth.
4. *Hylodes cerasinus*; 3a, mouth.

PLATE V.

- Fig. 1. *Leptognathus argus*; natural size.
2. *Teleüraspis schlegelii*; natural size.
3. *Bothriopsis proboscideus*; natural size.
4. *Hyla uranochroa*; natural size.

PLATE VI.

Heads of *Lacertilia* and *Ophidia*, natural size.

- Fig. 1. *Mabuia alliacea*, from above.
2. *Chalcidolepis metallicus*; a, above; b, below.
3. *Amiva gabbiana*; a, above; b, below.
4. *Anolis trochilus*, above.
5. *Anolis oxylophus*, above.
6. *Xiphosoma annulatum*: in this and the following figures, the superior view is marked a, the lateral b.
7. *Leptognathus argus* (a).
8. *Leptognathus pictiventris* (a and b).
9. *Leptophis æruginosus* (a and b).
10. *Leptophis saturatus* (a and b).
11. *Spilotes chrysobronchus* (a and b).
12. *Contia calligaster* (a and b).
13. *Bothriopsis proboscideus* (a).

A DESCRIPTIVE CATALOGUE
OF THE
SCALIDÆ OF THE WEST INDIA ISLANDS.

By O. A. L. MÖRCH, Ph.D.

OBSERVATIONS.

The present paper was originally destined to be part of a descriptive Catalogue of the collection of the late Robert Swift, of St. Thomas and Philadelphia; but additions from the collections of Mr. Henry Krebs and Mr. A. H. Riise and others have much increased the material not only in new species, but especially in numerous specimens in well-selected suites representing varieties and geographical distribution.

It was the intention to figure not only the new species, but also those rarer ones already figured only in rare or costly works; but circumstances have compelled a change of plan, and limit the illustrations to a single plate.

COPENHAGEN, May, 1875.

The Scalidæ of the West Indies.

The species of the genus *Scala* of Klein were by Linné associated with *Turritella*, *Clausilia*, &c. in the genus *Turbo*, from which Lamarck separated it under the name *Scalaria*; distinguishing it by its numerous varices from *Turritella*. A knowledge of the animal and its anatomy has, however, shown that those two genera are widely different; *Turritella* belonging to the DIOICA, order Tænioglossata (Troschel), having seven rows of teeth with reflected edges, proving its phytophagous habits; *Scala*, on the contrary, to the ANDROGYNA, order Ptenoglossata, having subulate multiseriate teeth wanting the median or rhachial tooth. This latter circumstance proves that the animal, like *Testacella* and *Ianthina*, swallows its food entire or in large morsels. In fact, *Scala grönlandica* feeds (according to Dr. Gould)* eagerly on fresh beef, especially if somewhat macerated. In the form of the teeth and in their predacious habits, the *Scalidæ* agree with *Ianthinidæ*, in

* Gould, *Invertebrata of Massachusetts*, 1841, p. 250.

the mouth of which often are found young individuals of the same species. The *Ianthinidæ* differ chiefly from *Scalidæ* by the floating apparatus adapted to their oceanic life. Between the shells there are some marked transitions, *e. g.* *Recluzia* and the ribbed *Ianthina* (*Iodina*) *exigua*, Lam., on one side, and *Scala* (*Ianthoscala*) *inconspicua*, Sow., *S. concinna*, Sow., &c., on the other. The *Scalidæ* may be considered creeping *Ianthinidæ*.

Several attempts have been made to divide the genus *Scala* into subgenera, but as yet none have proved successful. In Cat. Yoldi, 1852, p. 48, I adopted the following divisions:—

ACIONA, Leach, with the whorls separated. *S. scalaris*, L.

SCALA, Klein (Clathrus, Oken), whorls not separated.

CLATHRUS, Gray (*Scal. australis*, Linn., and *S. grönlandica*, Perry), with flat sutures.

CIRSOTREMA, Mörch, is generally adopted as a genus on account of the crispate varices.

ACIRSA, Mörch, Prod. Moll. Grönl. 1857; Adams' Gen. Supp. Chiefly founded on the want of varices; this character is, however, very doubtful. *Scala ochotensis*, Midd., which evidently is nearly specifically the same, has sometimes rather distinct ribs, and *Scala wroblewskyi*, Mörch (*Scalaria borealis*, Gould), is sometimes quite smooth.

In the Genera of H. and A. Adams, Nov. 1853, p. 220, the following subgenera are added:—

AMÆA, H. and A. Adams; *Scala minuta*, Bolt (*Scala martinii*, Wood.)

The chief characters, rudimentary ribs and spiral striæ, are not constant even in the same species. If the spiral line proves of generic value, *Scala grönlandica* would enter this genus chiefly, as *Scala lovénii*, Mac Andr., considered by several as a variety only, has spiniferous ribs like *Amæa minuta*.

OPALIA, H. and A. Adams, was established on species with a spiral basal ridge, a character probably of less importance, as *Scala lamellosa*, Lam., and *Scala australis*, Lam., scarcely can be congeneric.

ACRILLA, H. and A. Adams, Proc. Zool. Soc. 1860, p. 241. Type *Scala acuminata*, Sowb. Shell turritelloid, ribs filiform.

The geographical distribution of the *Scalidæ* agrees in many respects with the Corals, the number of species being largest in the tropical seas, chiefly on the coral islands, and smallest towards the poles.

Thus in the north polar region are only found four species: *Scala grönlandica*, Perry, is circumpolar; in the sea of Greenland and Labrador is found besides this species *Scala* (*Acirsa*) *borealis*, Beck (*Sc. eschrichtii*, Holb.), which is not found recent on the European side of the Atlantic Ocean, but occurs fossil in Sweden (Uddevalla), Ireland, &c.

In the northern part of the Pacific Ocean is found, besides *Scala grönlandica*,

Scala wroblewskyi, Mörch (*Scalaria borealis*, Gould, now Beck), *Scala ochotensis*, Midd., which may be considered a gigantic *Scala borealis*, Beck.

In the south polar region *Scala wroblewskyi* is represented by *Scala australis*, Lam., which resembles it so closely that Dr. Gould considered it identical, and for this reason retired his species. *Scala borealis*, Beck, is represented by *Scala granosa*, Q. and G., which was considered a *Turritella* on account of the want of ribs.

On the American Atlantic coast line, from Cape Cod to South Carolina, six species are indicated. In the tropical region, the Gulf of Mexico with its islands, the north coast of South America, which however is little known, are found forty species, of which only one is not found on the islands.

From Rio Janeiro to the Strait of Magellan only six species are again indicated.

On the American Pacific coast line, from Vancouver's Island to Upper California, Dr. Carpenter has enumerated about eleven species. In the tropical region from California to Peru twenty-six species. On the south coast of South America influenced by the polar stream no species is indicated except *Scala magellanica*, Phil., from the Straits of Magellan.

On the European side of the Atlantic Ocean, on the coast of Norway and England, are indicated four species, all of which are found also in the Mediterranean; in this sea and in the adjacent parts of the Atlantic from Portugal to Madeira, are found twenty-three species, of which a few only are found at Madeira.

From the tropical west coast of Africa about six species are indicated; at Cape of Good Hope about five species, among which is *Scalaria australis*, Lam.

On the Asiatic side of the Pacific Ocean, from Japan and China, are indicated about thirty-three species; from the Philippine Islands thirty five species, nearly all collected by the late Mr. Cuming.

From the Red Sea and India about twenty-five species; from New Guinea and the other Pacific islands about twenty species; and from New Holland and New Zealand about fourteen species are known.

The number of living species is probably about 240, which generally have a limited distribution, although several species by some authors are considered identical on both sides of the Atlantic Ocean and between India and the West Indies.

The West Indian fauna, containing forty species, is the richest in Scalidæ, but I suppose that the Philippines, when better investigated, will prove still richer.

D'Orbigny in his excellent "Mollusques de Cuba," published 1842,* indicates seven species, of which five are new.

* The two volumes have the year 1853. Vol. I. is, according to Troschel's "Jahresbericht," published in 1841, except the two last sheets which are from 1842; of Vol. II. the first seven sheets were published 1842.

G. B. Sowerby, Jun., in the "Thesaurus Conchyliorum," 1844, Part IV., containing ninety-four species, indicates ten species from the West Indies, of which eight are new.

In the present paper are enumerated forty species, of which eighteen are new and three for the first time identified as West Indian.

Synopsis Familiæ Scalidarum Indiarum occidentalium.

Fam. SCALIDÆ.

Gen. SCALA, Klein (*Scalaria*, Lam.).

Sect. *. *Aciona*, Leach.

1. SCALA KREBSII, Mörch, n. sp., Pl. 29, figs. 1 and 2.

T. umbilicata, ovata, polita, striis spiralibus aciculatis irregularibus; striæ incrementi obsoletissimæ; anfr. disjuncti ad suturam angulato-plani, convexi; costæ x in anfr. ult. ad suturam auritæ: apertura subcircularis, labio subreflexo. Color albus, in media parte anfr. pallide ferrugineus.

Long. 17 mm.; lat. $10\frac{1}{2}$ mm.; alt. aperturæ 6 mm.

Analogue of *Scala subpretiosa*, Blv. (*Sc. pallasii*, Kien.) Sowb. Thes. Conch. 1844, fig. 14; but the new species is much smaller.

Hab. St. Thomas "60' bl. S. Mud." H. Krebs (fig. 1), St. Martin, spm. juvenile (H. Krebs, fig. 2).

2. SCALA PRETIOSULA, Mörch, n. sp.

T. perforata, oblongo-ovata, lactea, politissima; striæ incrementi argutæ, obsoletissimæ; anfr. omnino disjuncti, sutura hiantæ; costæ viii in anfr. ult. compressæ, candidæ, foliaceæ, obsoletissime crispatae, suturam versus expansæ costæ 6 ult. antecedenti oblique adnatæ, cæteræ continuæ; apertura ovalis (sed. fracta in spm.).

Long. $11\frac{1}{2}$ mm.; lat. $6\frac{1}{4}$ mm.; alt. aperturæ 4 mm.

Hab. St. Martin (H. Krebs), two specimens; the smallest is 6 mm. long and 4 mm. broad.

Scala fasciata, Sowb., most nearly resembles this species. The whorls are completely separated, rendering the umbilicus visible through the sutural opening. The ribs are foliaceously dilated at the suture, touching the corresponding rib of the preceding whorl, but the last six ribs obliquely, giving the appearance of being alternate.

3. *SCALA PRINCIPALIS*, Pallas.

T. obtecte perforata, ovato-turrita, tenuiuscula, candida, nitidula, sub lente obsoletissime irregulariter spiraliter striata; anfr. x disjuncta, costis xiv regularibus acutis in anfr. ult.; apertura oblique ovalis, labio rectiusculo.

Long. 36 mm.; diam. 16 mm.; alt. aperturæ 10 mm.

Turbo principalis, Pallas, Spic. x. 1774, p. 32.

“ “ Naturg. merckwür. Thiere. x. 1778, p. 51, t. 3, f. 3, 6.

Angarius scalaris seu var. rarissima, Meuschen Mus. Gevers. 1787, p. 260, n. 203.

Die seltene enge geribbte Wendeltreppe, Martini, Berlin, Samml. Bd. vii. p. 28, tab. tit.

Turbo principalis, Chem. iv. p. 273, f. 1128, 29.

“ Schröter Journal, ii. p. 451.

Hab. Tortola, spm. unicum (A. H. Riise).

Scalaria principalis, Sowb., Thes. fig. 75, p. 88, n. 23, from Xipixapi, is different.

Scala ducalis, Mörch.

Scala costulata, Kien. Spec. Gen. differs chiefly in having the ribs more numerous and lower.

I am not aware that this species is found in any collection but that of Mr. Riise, now in Copenhagen.

4. *SCALA SWIFTII*, Mörch, n. sp., Pl. 29, fig. 3.

T. acuminato-ovata, vix perforata, alba, polita, lineis aciculatis, spiralibus, obsoletissimis; anfr. disjuncti, convexi vii-viii, sutura rimata; costæ foliaceæ in anfr. ult. xii, pagina antica obsoletissime rugoso-granulosa; apertura ovata, abbreviata, antice effusa, labio subtorto.

Long. 14 mm.; diam. 9 mm.; alt. aperturæ 5 mm.

Hab. St. Thomas (R. Swift), spm. unicum.

“*Scalaria bulbulus*, Sowb.,” Coll. Swift.

Scala obtusa, Sowb., is the species nearest allied. The aperture is effuse, like that of *Melania*; the ribs of the last whorl touch the front side of the corresponding ribs of the preceding whorl.

5. *SCALA NOVEMCOSTATA*, Mörch, n. sp.

T. abbreviato-turrita, imperforata, alba, nitida, tenuiuscula; anfr. disjuncti, convexi, rima angustissima; costæ compressæ, acutæ, altissimæ, continuæ, in anfr. ult. ix. Apertura suborbicularis, obsolete coarctata.

Long. 9 mm.; diam. $4\frac{1}{2}$ mm.; alt. aperturæ 2 mm.

Hab. St. Thomas (Riise), spm. unicum.

Scala hexagona, Sowb., and especially *Scala foliacea*, Sowb., from the Crag formation, are nearly allied to this species.

6. *SCALA SPURIA*, Mörch, n. sp.

T. imperforata, alba, polita, turrita, gracilis; anfr. disjuncti, sutura aperta, hians; costæ compressæ, continuæ viii-ix in anfr. ult. suturam versus angulati, pagina antica obsolete malleata; apertura adnata, ovata, labio recto, antice producto.

Long. 14 mm.; lat. $5\frac{1}{2}$ mm; alt. aperturæ 3 mm.

Pseudo-scalata, *Scala spuria*, Chem., Conch. Cab. iv, p. 275, f. 1438?

Hab. St. Thomas (Riise, Swift); Anguilla (Hornb.).

Is nearest allied to *Scala muricata*, Sowb., Thes. fig. 29. The shell is more elongated, the ribs only feebly angulated and not auriculated by the suture.

Chemnitz indicates St. Croix as habitat, and states that the operculum is yellow; but it must be recollected that the figured specimen was from Martini's Collection, and the described specimen from that of Chemnitz.

7. *SCALA FOLIACEICOSTA*, D'Orb., Pl. 29, fig. 6.

T. imperforata, elongato-conica, solidula, albida, nitidula; anfr. disjuncti xi convexiusculi; costæ vi-vii in anfr. ult., rectæ, altæ, ad suturam foliaceæ, auricula inflexa uncinata. Apertura suborbicularis adnata.

Long. $14\frac{1}{2}$ mm.; diam. $5\frac{1}{2}$ mm.

Scalaria foliaceicosta, D'Orb., Cuba, p. 17, ix, f. 26-28.

Scalaria aculeata, Sowb. Thes., p. p. fig. 35.

Hab. St. Thomas (Riise, Candé, Verkingen), St. Croix (Swift), Anguilla (Krebs); Martinique, Guadeloupe (Candé).

This species is analogous with *Scala tenuicostata*, Sowb., Thes. fig. 76, from the Philippine Islands. The ribs are auriculate at the sutures, produced and inflected.

8. *SCALA SPINÆ-ROSÆ*, Mörch, n. sp.

T. turrita, alba, imperforata; anfr. vix disjuncti, ad suturam planati; costæ crassæ, in anfr. ult. x continuæ, obliquæ, compressæ, non reflexæ, ad suturam spina brevi divergente; ambulacra torta sigmoidea; apertura subcircularis.

Long. $7\frac{1}{2}$ mm.; lat. $3\frac{1}{2}$ mm.

Hab. St. Thomas (H. Krebs), specimen unicum.

Analogue of *Scala aculeata*, Sowb., Thes. fig. 37.

9. *SCALA CENTIQUADRA*, Mörch, Pl. 29, fig. 4.

T. imperforata, abbreviato-turrita, alba, tenuis, pulcherrime decussata; lineæ spirales confertissimæ, alternatim majores et minores, line incrementi approximatae, capillares, sat regulares; anfr. convexi, sutura profundissima; costæ foliaceæ et præsertim postice subreflexæ, ad suturam spina brevi inflexa munitæ, pagina antica lineis transversis rugulosa. Apertura subovalis, labro strictiusculo, antice incrassato.

Long. $15\frac{1}{4}$ mm.; lat. 7 mm.; alt. aperturæ 5 mm.

Scalaria denticulata, Sowb., Thes. p. 87, t. 32, f. 25-26 (non Mg.)

Hab. Anguilla (H. Krebs); St. Thomas, St. Croix (Hornb., Swift, Riise, Krebs), Bahama (Riise).

Chiefly distinguished by its beautiful decussated sculpture between the ribs, arising from the filiform spiral lines of various thickness, generally alternating, every second, third, or fifth being thicker; and the lines of growth, which are very thin and capillaceous.

*Sect. **. Costis undulato-dentatis.*

10. *SCALA SOLUTA*, Dkr., n. sp., Pl. 29, fig. 5.

T. umbilicata, candida, polita, abbreviato-turrita; anfr. primi lævigati, sutura profunda, ult. tres soluti; costæ x in anfr. ult., lobis 4, parvis per paria digestis, posteriores 2 majores. Apertura circularis, labro lobato.

Long. 5 mm.; diam. $2\frac{1}{2}$ mm.

Scalaria soluta, Dkr., MSS. in Mus. Riise.

Hab. St. Thomas (Krebs); Smith's Bay (Riise).

Scala hyalina, Sowb., Thes. fig. 21, from the Philippine Islands, is the nearest allied species.

11. *SCALA ECHINATICOSTA*, D'Orb.

T. abbreviato-turrita, lactea; anfr. tres primi lævigati, adnati, cæteri soluti; costæ quadrilobatæ, in anfr. ult. xii. Apertura soluta, circularis, labio 4- vel 5-lobato.

Long. $3\frac{1}{2}$ mm.; lat. 2 mm.

Scalaria echinaticosta, D'Orb., Cuba, 2, p. 18, t. 11, f. 4-6.

Hab. St. Thomas (Swift, Riise).

Var. α. BLANDII, Pl. 29, fig. 8

T. abbreviato-turrita, lactea, perforata; anfr. disjuncti; costæ x in anfr. ult., huc illuc continuæ, foliaceæ, vix reflexæ, margine undulato-lobato. Apertura soluta, pisiformi-ovalis.

Long. $5\frac{1}{4}$ mm.; diam. 2 mm.

Hab. St. Thomas (Krebs).

The variety differs in having the suture less open, the lobes on the ribs smaller and more numerous; sometimes the ribs are continuous from one whorl to another.

12. *SCALA VOLUBILIS*, Mörch.

T. anfr. valde discreti, costis xiii in anfr. ult. brevissimis, undulatis, vix lobatis.

Long. 4 mm.; diam. 2 mm.; apertura diam. 1 mm.

Hab. St. Thomas; specimen unicum spira fracta (H. Krebs).

Scala hyalina, Sowb., Thes. fig. 22, is very like to this species.

*Sect. ***.*13. *SCALA PERNOBILIS*, Fischer and Bernardi.

T. imperforata, tenuis, alba, abbreviato-conica; anfr. v-vi convexi, lamellis copiosis elevatis, recurvis, superne subangulatis, ad marginem tenuibus simplicibusque; anfr. ultimus dilatatus, permagnus, non solutus. Apertura rotunda, columella incrassata, callosa, umbilicum tegens, peristomate crasso, lamella valida, superne producta et angulata.

Long. 40 mm.; lat. 33 mm.

Scalaria pernobilis, Fisch. and Bern., Journ. de Conch. 1854, p. 293, t. 8, f. 23.

Hab. Guadeloupe (Com. Bean).

The only known specimen was found on a fisherman's bow-net, together with *Pleurotomaria quoyana*, Crosse, and like this inhabited by a hermit crab. It is now preserved in the "Musée des Colonies" in Paris.

A very similar species, but very thick in the shell and fossil, is in the Jardin des Plantes and was obtained as the type specimen.

14. *SCALA OCCIDENTALIS*, Nyst.

T. imperforata, tenuis, alba, lævis; anfr. subsoluti, ad suturam depressi; costæ foliaceæ, obliquæ, continuæ, ad suturam angulatæ, huc illuc subauriculatæ, postice excavatæ, xiii-xiv in anfr. ult. Apertura reniformi-ovalis. Operculum flavum.

Long. 13 mm.; diam. $6\frac{1}{4}$ mm.

Scalaria tenuis, Sowb., Proc. Zool. Soc. 1844, p. 110 (non Gray).

" Sowb., Thes. p. 87, fig. 67.

Scalaria occidentalis, Nyst., Tableau 1873, p. 48.

Hab. St. Thomas (Hornb., Riise, Krebs, H. Kock.), Nassau (Krebs); Crabben Island (Unger).

Var. AURITA; in anfr. ult. costis xi crassiusculis.

Long. 11 mm.; diam. $5\frac{1}{2}$ mm.

Hab. St. Thomas (Riise).

This variety reminds me of *Scala foliaceicosta*, D'Orb.

15. *SCALA ERECTISPINA*, Mörch, n. sp.

T. minuta, imperforata, elongata-turrita, solidula, alba; anfr. contabulati, suturis excavatis profundis; costæ xiii in anfr. ult. postice excavatæ ad suturam, auriculis acutis erectis subreflexis vel tortis, postice excavatis uti canaliculatis. Apertura circularis, labio antice incrassato, producto, torto.

Long. $4\frac{3}{4}$ mm.; diam. $2\frac{1}{4}$ mm. Aperturæ alt. $1\frac{1}{4}$ mm.

Hab. St. Thomas (Riise).

This species is very like the preceding in the contabulate whorls, but is exceedingly small; from the following species it differs in being more elongate, not perforated, and having the aperture less lobed anteriorly.

16. *SCALA MICROMPHALA*, Mörch, n. sp.

T. minuta, obtecte-perforata, abbreviato-turrita, alba, spira flavescens; anfr. contabulati sutura profunda; costæ xviii in anfr. ultimo, valde reflexæ, postice excavatæ, auriculis erectis postice canaliculatis paululum reflexis. Apertura circularis, columella producta lobata.

Long. 5 mm.; diam. 3 mm.; aperturæ alt. 2 mm.

Hab. Vieque (Riise); spm. unicum.

Scalaria neglecta, Ad. and Reeve, is very like in shape.

17. *SCALA QUINDECIMCOSTATA*, Mörch, n. sp.

T. turrita, angusta, lactea, nitida; anfr. convexi disjuncti sed rima suturali angustissima; costæ regulares, acutæ, compressæ, validæ, candidæ, xv in anfr. ult. Apertura subovalis, antice obsolete angulata, labio duplice.

Long. $8\frac{3}{4}$ mm.; diam. 3 mm.

Hab. St. Thomas (A. H. Riise); spm. unicum.

Differt a *Sc. clathratula*, Mtg., testa majore, anfr. disjunctis.

18. *SCALA VENOSA*, Sowb., Pl. 29, fig. 9.

T. elongato-turrita, imperforata, lævis, lactea; anfr. 9 disjuncti, varicibus xi in anfr. ult., crassis, valde reflexis, approximatis, ad suturam subangulatis impressione torta. Apertura oblique ovalis.

Long. 13 mm.; diam. 5 mm.

Scalaria venosa, Sowb., Thes. I. p. 89, t. 33, f. 72-73.

Var. α varicibus vix reflexis.

Hab. St. Thomas (Swift, Krebs, Riise); Puerto Cabello, in the Lagoon (Dr. Prosch); Maracaibo (Riise); Vieque (Riise).

Scal. modesta, C. B. Adams; Coll. Swift.

19. *SCALA ORBIGNYI*, Nyst.

T. elongato-turrita, solida, alba, imperforata, sutura profundissima; costæ xiv in anfr. ult. brevissimæ, ad suturam angulata; apertura ovalis.

Long. 15 mm.; diam. $6\frac{1}{4}$ mm.

Scalaria elegans, D'Orb., Am. mér. p. 389, t. 54, f. 1-3 (non Risso).

Scalaria Orbignyï, Nyst. Tabl. 1873, p. 48.

Hab. St. Thomas (Krebs).

I refer to this species with some doubt, a worn specimen.

Scalaria georgettina, Kiener, is nearly allied.

20. *SCALA GRADATELLA*, Mörch, n. sp., Pl. 29, fig. 11.

T. imperforata, gracillima, lactea, polita; costæ candidæ, obliquæ, superne ad suturam anguliferæ vel obsolete auritæ, in anfr. ult. xi; sutura canaliculata, constricta. Apertura ovalis.

Long. $11\frac{1}{2}$ mm.; diam. 3 mm.

Hab. St. Thomas; specimen unicum (H. Krebs).

Scala gradata, Sowb., is very like in shape, but much larger.

*Sect. ****. Turbona*, Browne.

21. *SCALA UNIFASCIATA*, Sowb., Pl. 29, fig. 13.

T. turrita, imperforata, solida, nitida, alba, fascia ferruginea suturali, huc illuc striis spiralibus subtilissimis; anfr. convexiusculi, sutura simplice; costæ vii in anfr. ult., continuæ, ambulacra vix torta. Apertura circularis labio incrassato antice subcrenulato, angulaproducto.

Long. 10 mm.; diam. 4 mm.

Scalaria unifasciata, Sowb., Thes. p. 98, t. 33, f. 68.

Hab. Anguilla, St. Vincent (Riise, Krebs, Swift, Ravn.); St. Croix (Oersted); St. Martins (Krebs); St. Jan. (Riise); Guadeloupe (Swift).

22. *SCALA UNDECIMCOSTATA*, Mörch, n. sp.

T. imperforata, abbreviato-turrita, solidissima, lactea vel isabellina, subtilissime et confertissime spiraliter striata; anfr. convexi, sutura profunda; costæ candidæ, crassæ, triquetrae, regulares, æquales circ. xi in anfr. ult., ad suturam expansæ, antrorsum adnatæ; ambulacra obliqua vix torta. Apertura ovalis pariete aperturali oblecto, labro crasso antice angulato.

Long. $10\frac{1}{4}$ mm.; diam. $4\frac{1}{2}$ mm.

Hab. St. Thomas (Krebs, Riise); Jamaica (Verkr.).

Allied to *Scala monocycla*, Lam.

23. *SCALA OCTOCOSTATA*, Mörch, n. sp.

T. gracilis, alba, polita, striis spiralibus subtilis simis sub lente vix detegendis; anfr. convexiusculi, sutura impressa; costæ viii in anfr. ult. simplices, continua, humiles, ambulacra torta sigmoidea. Apertura obovata, pariete vix tecto, labio antice incrassato subeffuso.

Long. 8 mm.; diam. 3 mm.

Hab. St. Thomas; spm. unicum (H. Krebs).

Scala Elenensis, Sowb., is the nearest allied.

24. SCALA EBURNEA, Pot. and Mich., Pl. 29, fig. 10.

T. turrita, tenuiuscula, imperforata, albida, nitida, striis spiralibus obsoletissimis parcis; anfr. convexi, sutura impressa; costæ xii-xiii in anfr. ult. argutæ, margine reflexo præsertim ad suturam; ambulacra angusta torta. Apertura subovalis, pariete oblecto; labio antice incrassato.

Long. 20 mm.; diam. $7\frac{1}{2}$ mm. (spm. permagnum).

Scalaria eburnea, Pot. and Mich. 1838, Cat. Douai, p. 344, t. 31, f. 1-2.

Scalaria fragilis, Gray, Hanley, Textbook, 1842, pp. 63, 158; Sowb., Thes. 1, p. 88, t. 33, f. 164, 65, 66.

Scalaria albida, D'Orb., Cuba, p. 17, t. 20, f. 24, 25 (1853).

Scalaria ligata, C. B. Adams, Contr. No. 4, p. 67?

Var. α. Angusta.

Hab. Cuba (Aubér); St. Thomas (Dr. Ravn, Bardenfl., Riise, Krebs); St. Martin (Krebs); Trinidad, Barbadoes (Krebs); Anguilla (Hornb.); St. Vincent (Sowb.).

Var. β.? Costis membranaceis valde reflexis.

Long. 14 mm.; diam. $6\frac{1}{4}$ mm.

Hab. Nassau (Krebs).

Var. γ.? Pumilio.

Long. $7\frac{3}{4}$ mm.; diam. 4 mm.

Hab. Porto Plata, St. Barth. (Krebs).

25. SCALA LAMELLOSA, Lam.

T. imperforata, clavata; anfr. convexi sutura impressa; costæ compressæ acutæ, xii-xiii in anfr. ult.; ambulacra fere recta. Apertura subovalis, labio antice angulato. Color albus, fascia suturali, periomphali et maculis intermediis fuscis. Operculum flavum, ovale, nucleo excentrico, striæ incrementi capillares.

Long. 40 mm.; diam. 16 mm. (spm. giganteum).

Long. 31 mm.; diam. $14\frac{1}{2}$ mm. (spm. typ.).

Var. α, unicolor, castanea; Kien, spec. gen. t. 3, f. 7^a.

Var. β, alba, fascia suturali fusca.

Var. γ, alba, fascia suturali et basali (supra lineam) fuscis.

Var. δ, alba, fascia suturalis et basali (infra lineam) fuscis.

Var. ε, costæ reflexa, crassitil varia et alternatim non contiguæ.

Var. ζ, costæ ultimæ tres latissimæ confluentes; lat. 8 mm.; long. testæ 30 mm.

Turbo clathrus, L. S. N. xii, p. 1237, n. 631, non S. N. x.

Scalaria pseudoscalaris, Brocchs, D'Orb., Cuba, p. 15, n. 191.

Scalaria clathrus, L., Sowb., Thes. p. 101, f. 134, 131, 132.

Hab. Very common throughout the West Indies—St. Thomas, St. Jean, Pas-

sage Island; young specimens on dead Madrepores from three feet depth (Krebs); St. Jean, Vieque (Riise); Guadeloupe (Bean).

This species, which is the most common in the West Indies, is generally considered identical with allied species in the Mediterranean and Pacific.

1. *Scala pseudoscalaris*, Brocchi, Desh., from the Mediterranean, differs by the shell being much narrower, the ribs equal, and the ambulacra nearly straight.

2. *Scala perplexa*, Pease, Proc. Zool. Soc. 1860; Am. Journ. of Conch. iii, p. 228; Desh. Moll. Reunion, p. 60, t. viii, f. 1, v. Martens Donum Bismarckianum, t. i, f. 19.

Differs in having single high ribs alternating with pairs of lower ribs.

26. SCALA CORONATA, Lam.

T. tenuis, lineis spiralibus sub lente distinctissimis; anfr. perconvexi sutura constricta, costæ xv -xvi in anfr. ult., lineares sed 1 vel 2 crassiores. Color albus, fasciis angustissimis 3 e maculis obliquis compositis; fascia suturali angusta plerumque obsoleta.

Long. 33 mm.; diam. 14 mm.

Scaloria coronata, Lam., Enc. Méth. 1816, Pl. 451, f. 5; Lam. Hist. vi, p. 227, n. 3; Lam. Hist. ed. Desh. ix, p. 74, n. 3; Desh. Enc. Méth. iii, p. 930 (1832); Kiener, Spec. Gen. tab. 3, f. 8^a; Sowb. Thes. p. 101, f. 133^a; Bean, Cat. Moll. Guadel. p. 12.

Hab. Antilles (Dr. Ravn. Com. Falsen, Nissen, Mrs. Eckardt); Guadeloupe (Bean).

In the collection of Christian, VIII, are found five specimens from the above collectors about from the years 1833-39, but I am not aware that this shell has since been collected at the Danish Antilles. Kiener indicates Cape of Good Hope as the locality for this species, but no author has since confirmed this assertion. The figure in the Encyclop. Méth. is the best, showing the whorls very convex and the sutures deep. The figures of Kiener and Sowerby show flat whorls like the preceding species. Mr. Deshayes indicates the number of ribs on the last whorl as 19-20.

*Sect. *****. Amœa*, H. and A. Adams.

27. SCALA (AMŒA) TURRICULA, Sowb., Pl. 29, fig. 7.

T. obtecte perforata, turrita, gracilis, alba, fasciis 2 interruptis ferrugineis, spiraliter lirata; liræ confertissimæ, ad regionem suturalem regulares, interstitia majora funiculis confertis munita; costæ xii-xiii in anfr. ult., plerumque lineares simplices, ultima et penultima et huc illuc in anfr. spiræ crassæ, ad suturam spinula adunca munitæ. Apertura ovalis, peristomate continuo ad umbilicum angulatum.

Long. 15 mm.; diam. 6 mm. (Fragm. spm. maj.), diam. 7 mm.

Scalaria turricula, Sowb., Thes. p. 92, f. 61, 88 (non Cantr.).

Scalaria turrita, Nyst., Tabl. 1873, p. 66 (non Blv.).

Var. α. T. in anfr. ult. costis crassis 5, quarum 2 ad aperturam et 3 ad finem anfr. penult. Long. 11 mm.; diam. 5 mm.

Var. β. T. unicolor, ferruginea, costis albis, Sowb., Thes. f. 61.

Hab. St. Thomas, Anguilla, Water Island, St. Martin (Riise, Krebs).

28. SCALA UNCINATI-COSTA, D'Orb.

T. minuta, imperforata, turrita, unicolor, alba vel flavescens; liræ spirales distinctæ, expressæ, regulares, interstitiis lævibus; costæ xii in anfr. ult. regulares, æquales, crassæ, ad suturam spina adunca obliqua. Apertura ovalis, peristomate continuo antice incrassato.

Long. 7 mm.; diam. $2\frac{1}{2}$ mm.

Long. $7\frac{1}{2}$ mm.; diam. 4 mm. Spm. magnum unicum.

Scalaria uncinati-costa, D'Orb., Moll. de Cuba, 1852, p. 25, t. xi, f. 25–27.

Hab. St. Thomas 60' bl. S. M. (H. Krebs); Guadeloupe (Candé).

Differs from the preceding in being much smaller, having regular and thick ribs provided with a minute sutural spine. D'Orbigny indicates the color as "rosea." It looks like a diminutive *Scala Loveni*, Me. Andrew.

29. SCALA CANDEANA, D'Orb.

T. imperforata, turrita, lactescens, nitens, sutura impressa; liræ spirales distinctæ, regulares, approximatae, interstitiis lævissimis, interdum lirula intercalante; costæ xii interdum xvi in anfr. ult., crassiusculæ, sæpe duplicatae, continuæ, simplices. Apertura ovalis, labio incrassata duplice, peristomate continuo.

Long. 9 mm.; diam. 3 mm. (spm. max.)

Long. 6 mm.; diam. 2 mm. (spm. vulg.)

Scalaria Candéana, D'Orb., Moll. Cuba 2, 1852, p. 20, t. vi, f. 28–30.

Scalaria acuta, Pfr. Archiv f. Naturg. 1840, p. 256 (teste Troschel, Jahresbericht, ibid. 1842).

Hab. Jamaica, St. Thomas (Candé); Smith's Bay (Riise).

I refer my specimens to the species of D'Orbigny, although the author indicates the number of ribs in the last whorl as 20–25, which does not agree with the figure. Of six specimens, only one has sixteen ribs. The measure of D'Orbigny indicates too a very small individual. *Scala grönlandica*, Perry, gives a good idea of this little shell.

30. *SCALA TURRITELLULA*, Mörch, n. sp.

T. minuta, imperforata, turrita, gracilis, spiraliter expresse lirata; anfr. convexi, sutura constricta; anfr. primi lævigati; costæ lineares circ. xxv in anfr. ult., ad suturam expansæ. Apertura ovalis pariete crasso, antice producta.

Long. 6 mm.; diam. 2 mm.

Hab. St. Martin (Lilienskiold, Krebs).

Var. α. Riisei. *T. turrita*, gracilis, spiraliter dense lirata; anfr. rotundati, contabulati, sutura constricta profundissima; nucleus (anfr. primi 4) lævigatus fuscus, nutans (casu?); costæ expressæ, angustæ, ad suturam angulatæ 25 in anfr. ult, huc illuc anguliferæ. Apertura ovalis, peritremate ad suturam et basin angulato.

Long. $6\frac{1}{2}$ mm.; diam. 2 mm.; spm. minus long. 4 mm.; diam. $1\frac{1}{4}$ mm.

Hab. St. Thomas (Riise); Porto Plata (Krebs).

31. *SCALA ÆOSPILA*, Mörch, n. sp.

T. obtecte perforata, turrita, albida, politissima, maculis ferrugineis, striis spiralibus distantissimis obsoletissimis; striæ incrementi distinctæ; anfr. convexi sutura impressa; costæ x in anfr. ult., lineares, ult. 2 crassiores. Apertura ovata obliqua. Color cinereo-albus, maculis ferrugineis rotundis vel obliquis in duplice serie digestis in anfr. spiræ et in triplice serie in anfr. ult.

Long. $14\frac{1}{2}$ mm.; diam. 6 mm.

Hab. St. Croix (Ovesen); St. Thomas, spm. maculis obliquis Hornbeck (coll. C. M. Poulsen).

The reddish spots are arranged so that one pair belongs to each rib. The polished surface is very notable. *Scala nova-angliæ*, Couth, seems, according to the figure, to be most allied to it.

32. *SCALA NAUTLÆ*, Mörch, n. sp., Pl. 29, fig. 12.

T. subulata, imperforata; anfr. convexi circiter 8, sutura subimpressa; costæ xii in anfr. ult., ad suturam angulatim reflexæ, lineares; ult. 2 crassiores. Apertura ovalis. Color lilacinus anfr. ult. et penult. medio ferruginei, costæ et sutura albæ.

Long. $12\frac{1}{2}$ mm.; diam. $3\frac{3}{4}$ mm.

Hab. ad litus mexicanum inter Vera Crux et Nautla (Rathsack, 1842).

33. *SCALA FILARIS*, Mörch, n. sp.

T. imperforata, subulata, tenuis, nitida, striis spiralibus parcis obsoletissimis, albescens, sutura utrinque fascia flava lata; anfr. ult. costis xiv antice obsoletis, ad basin linea elevata circumscriptus. Apertura subovalis.

Long. $10\frac{1}{4}$ mm.; diam. $3\frac{1}{2}$ mm.; apertura alt. 3 mm.

Hab. St. Martin (Krebs, Swift), spm. trita.

Differt a præcedente anfr. convexioribus et costis tenuioribus.

Scala fusca, Sowb., from Sierra Leone, is not very unlike.

*Sect. *****. Janthoscala.*34. *SCALA MODESTA*, C. B. Adams.

T. imperforata, abbreviato-turrita, flavescens alba, solida; anfr. convexi, sutura simplex; costæ regulares crassiusculæ xxi in anfr. ult., interstitiis lævigatis. Apertura ovalis, pariete aperturali tenuissima; peristomate postice angulato.

Long. $2\frac{1}{2}$ mm.; diam. $1\frac{1}{4}$ mm.

Scalaria modesta, C. B. Adams, Proc. Bost. Soc. Jan. 1849, p. 5.

Scalaria modesta, Sowb., Reeve, Iconica, 1873, t. xi, f. 78.

Hab. Porto Plata (Krebs), spm. unicum; Jamaica (C. B. Adams), without umbilicus much thicker, more elongate than the following species. *Scala concinna*, Sowb. Thes. No. 55, f. 66, is much more nearly allied.

35. *SCALA INCONSPICUA*, Sowb.

T. obtecte perforata, ovata, solidula, lactea, anfr. convexi, ad suturam impressam depressi, striis spiralibus remotis; costæ regulares lineares xxxi in anfr. ult. Apertura ovalis, columella recta antice subeffusa, peristomate subcontinuo.

Long. $6\frac{1}{4}$ mm.; diam. 4 mm.

Scalaria inconspicua, Sowb. Thes. p. 90, No. 30, t. 33, f. 53.

Var. α, inflata. Long. 9 mm.; diam. $5\frac{1}{8}$ mm.

Hab. St. Croix, St. Thomas (Swift, Riise); Vieque (Riise). The var. from St. Thomas (considered a distinct species by Professor Dunker) is in the collection of Mr. Riise.

*Sect. *****. Opalia*, H. & A. Adams.36. *SCALA (OPALIA) CRENULATA*, Kiener.

T. abbreviato-turrita, imperforata, crassa, lactea, spiraliter subtiliter et confertissime, tæniatim fortiter striata; periomphalo costa crassa obsoleta; lira crassa spirali in anfr. ult. sub suturam evanescens; sutura canaliculata foveolato-dentata; costæ continuæ, in anfr. ult. evanescentes, dentes suturales 13 solum substant. Apertura oblongo-ovalis obliqua.

Long. 17 mm.; diam. 7 mm.

Scalaria crenulata, Kien. Icon. p. 17, t. 6, f. 18.

Scalaria crenata, L., Sowb. Thes., p. 505, No. 88, fig. 123.

Scalaria sp., Weinkauff, Mittelm., p. 241.

Hab. St. Thomas (Riise); Porto Plata, St. Martin, Anguilla (Krebs); Jamaica (C. B. Adams); Arecibo (J. W. Newton).

The described specimen is from Mr. Riise's collection, the other being imperfect. This species is also much broader than the Mediterranean species *S. crenata*.

37. SCALA (OPALIA) HOTESSERIANA, D'Orb.

T. imperforata, turrita, subcylindrica, crassa, leviter flexa, alba vel interdum lilacina, subtilissime spiraliter striata; sutura foveolata sed non canaliculata; costæ crassæ, convexæ, obliquæ xi-xii in anfr. ult.; costa basali crassa utrinque foveolata. Apertura orbicularis, peritremate crasso, antice producta.

Long. 11½ mm.; diam. 4 mm.; sed plerumque minor.

Scalaria Hotesseriana, D'Orb., Cuba, p. 16, t. xi, f. 22-23.

Scalaria crassicosta, Mus. Brit., Sowb. Thes. p. 104, No. 83, f. 119 (non Desh.)

Rissoa crassicosta, C. B. Adams, Proc. Bost. Soc., Jan. 1845, p. 6.

Scalaria grossicostata, Nyst., Tabl. 1873, p. 36, No. 136.

Turbo coniferus, Mtg. Brit. Shells, p. 314?

Hab. Guadeloupe (Hotessier); St. Martins (Swift); St. Thomas (Krebs, Riise).

38. SCALA (OPALIA) SCÆVA, Mörch, n. sp.

T. imperforata, turrita, albescens, spiraliter et subtilissime confertissime, striata; anfr. convexi, obsoletissime confertissime striata; anfr. convexi, medio obsoletissime angulati, costæ crassæ confertæ, versus suturam attenuatæ, in anfr. ult. circ. xv obliquæ plicæ formes, umbilicum versus sæpe evanescentes; spira varioribus 2; sutura crenulata. Apertura ovalis, peritremate crasso.

Long. 13 mm.; diam. 4½ mm.

Var. α, costis obsoletis. Long. 12 mm.; diam. 4 mm.

Hab. St. Thomas (Krebs, Riise).

39. SCALA (OPALIA) SUBVARICOSA, Dkr. (MSS.), n. sp.

T. turrita, subcylindrica, imperforata, lactea, subtilissime et confertissime spiraliter striata; anfr. medio angulati; costæ obsoletæ, pone angulum furcatæ; anfr. ult. carinis 2, carina anteriore minore nodosa; sutura foveolata; fovæ circ. 16 in anfr. ult. Apertura ovalis, peritrema marginatum.

Long. 14 mm.; diam. 4 mm.

Hab. St. Thomas, Anguilla (Krebs, Riise); Bahama (Riise).

Scalaria crassilabris, Sowb. Thes. p. 87, f. 115, is very like the species.

Var. pumilio, spira varicibus crassioribus sparsis.

Long. 5 mm; diam. 2 mm.

Hab. St. Thomas (Krebs, Riise); Bahama (Riise). A very large specimen.

*Sect. *****. Cirsotrema*, Mörch.

40. SCALA (CIRSOTREMA) COCHLEA, Sowb.

T. turrita, imperforata, alba vel pallide ferruginea; anfr. contabulati, sutura canaliculata, liris circ. 5 squamosis, varicibus 3 ad suturam angulatis, dorsalibus, continuis; laminæ incrementi confertæ, undulatæ, reflexæ, margine utrinque expansæ, depressæ, lineis divaricatis, sæpe approximatae vel fere confluentes vel huc illuc foramina orbicularia formantes. Sutura et costa spirali basali laminis incrementi utrinque septa. Apertura subcircularis. Operculum nigrum.

Long. 40 mm.; diam. 13 mm.; alt. aperturæ 7 mm.

Scalaria varicosa, Gray, Wood Supp. 1828, t. 6, f. 19?

Scalaria cochlea, Sowb., Thes. p. 103, fig. 142.

Scalaria varicosa, Lam., Skand. Naturforsker Möde, 1846, p. 938.

Scalaria attenuata, "Helbl."* Beck, ibid.

Hab. St. Thomas (Hornbeck); St. Croix (Riise, Krebs); St. Domingo (Shomburgk, B. Mus.) Tortola in mud, 1-2 feet water (Swift).

In good specimens the edges of the ribs are dilated, touching each other, only leaving some small interstices formed by the undulations of the lines of growth; the surface between the ribs is thus quite concealed.

I feel convinced that the specimen figured in Thesaurus, fig. 142, in reality is from the West Indies, and not as indicated collected by Dr. Thams at Loanda. The figure 143 is without doubt from the latter locality, a specimen from Fayal, in Rob. Swift's collection, agreeing exactly as well with Sowerby's as Dunker's figure in Mollusca Guineensia.

Scalaria fimbriata, Lam., Enc. Meth. 1816, t. 451, f. 4.

Scalaria varicosa, Lam., hist. p. p.

Scala crispa, "Lam.," Kien. Spec. gen. t. iv, f. 12, not Lam.†

Scalaria varicosa, p. p. Sowb., Thes., fig. 143.

Scalaria cochlea, Dkr. Moll. Guineens., t. 2, f. 47-48.

* Böhmsche Privatgesellschaft iv, 1799, p. 114, tab. 1, f. 20.

Which is a fossil species.

ALPHABETICAL LIST OF THE SPECIES OF SCALIDÆ MENTIONED IN THIS PAPER.

Acuta, Pfr., No. 29.
 Aculeata, Sowb., No. 7.
 Albida, D'Orb., No. 24.
 Attenuata, Helbl., No. 40.

Æospila, Mörch, No. 31.

Candeara, D'Orb., No. 29.
 Centiquadra, Mörch, No. 9.
 Clathrus, L., No. 25.
 Concinna, Sowb., No. 34.
 Cochlea, Sowb., No. 40.
 Coniferus (Turbo), No. 37.
 Coronata, Lam., 26.
 Crassicosta, Br. Mus., 37.
 Crassicostata, Nyst., No. 37.
 Crassilabris, Sowb., No. 39.
 Crenata, L., No. 31.
 Crenulata, Kien., No. 31.

Denticulata, Sowb., No. 9.
 Ducalis, Mörch, No. 3.

Eburnea, Pot. and Mich., No. 24.
 Echinaticosta, D'Orb., No. 11.
 Elegans, D'Orb., No. 19.
 Elenensis, Sowb., No. 23.
 Erectispina, Mörch, No. 15.

Fasciata, Sowb., No. 2.
 Filaris, Mörch, No. 33.
 Foliacea, Sowb., No. 5.
 Foliaceicosta, D'Orb., No. 7.
 Fragilis, Gray, Hanl., No. 24.
 Fusca, Sowb., No. 33.

(206)

Gradata, Sowb., No. 20.
 Gradatella, Mörch, No. 20.

Hexagona, Sowb., No. 5.
 Hotesseriana, D'Orb., No. 37.
 Hyalina, Sowb., Nos. 16 and 12.

Inconspicua, Sowb., No. 34.

Krebsii, Mörch, No. 1.

Lamellosa, Lam., No. 25.
 Ligata, C. B. Adams, No. 24.

Micromphala, Mörch, No. 16.
 Muricata, Sowb., No. 29.
 Modesta, C. B. Ad., No. 34.

Nautlæ, Mörch, No. 32.
 Novangliæ, Couth., No. 31.
 Novemcostata, Mörch, No. 5.

Obtusa, Sowb., No. 4.
 Occidentalis, Nyst., No. 14.
 Octocostata, Mörch, No. 23.
 Orbignyii, Nyst., No. 19.

Pallasii, Kien, No. 1.
 Perplexa, Pease, No. 25.
 Pernobilis, Fisch. and Bern., No. 13.
 Pretrosula, Mörch, No. 2.
 Principalis, Pallas, Sowb., No. 3.
 Pseudoscalaris, Brocchi, No. 25.

Quindecimcostata, Morch, No. 17.

Scæva, Mörch, No. 38.

Soluta, Dkr., No. 10.
 Spina-rosæ, Mörch, No. 8.
 Spuria, Mörch, No. 6.
 Subpretiosa, Blv., No. 1.
 Subvaricosa, Dkr., No. 39.
 Swiftii, Mörch, No. 4.

Tenuicostata, Sowb., No. 7.
 Tenuis, Sowb., No. 14.
 Turricula, Sowb., No. 27.
 Turrita, Nyst., No. 27.

Turritellula, Mörch, No. 30, 21.

Undecimcostata, Mörch, No. 22.
 Unifasciata, Sowb., No. 21.
 Uncinaticosta, D'Orb., No. 28.

Varicosa, Gray, No. 28.
 Venosa, Sowb., No. 18.
 Volubilis, Mörch, No. 12.

Wroblewskyi, Mörch, No. 1.

EXPLICATIO TABULÆ 29.

Fig. 1. Scala Krebsii, Mörch, No. 1.

2. " " " "
3. " Swiftii, Mörch, No. 4.
4. " centiquadra, Mörch, No. 9.
5. " soluta, Dkr., No. 10.
6. " foliaceicosta, D'Orb., No. 7.
7. " turricula, Sowb., No. 27.

Fig. 8. Scala echinaticosta, D'Orb., var.

- Blandii, No. 11.
9. " venosa, Sowb., No. 18.
10. " eburnea, Pot. & Mich., No. 24.
11. " gradatella, Mörch, No. 20.
12. " Nautlæ, Mörch, No. 32.
13. " unifasciata, Sowb., No. 21.



1. *Cranopsis fastidiosus*. 2. *Crepidius opoticus*. 3. *Ollotis cœrulescens*. 4. *Bufo auritus*. 5. *B. c. viridis*. 6. *Dendrobates talamancæ*. 7. *Hyla nigripes*. 8. *Phyllobates hylæformis*. 9. *Lithodytes podiciferus* var. I. 10. *L. melanostictus*. 11. *L. megacephalus*. 12. *Tryphlops chrysoprasinus*. 13. *Lithodytes muricinus*.

F. Sinclair & Son. Lith. Phila.



P. Smeclair & Son. Lith. Phila

1. *Anolis insignis* $\frac{1}{2}$. 2. *A. microtus* $\frac{1}{2}$. 3. *A. pachypus* $\frac{1}{2}$. 4. *A. oxylophus* $\frac{1}{2}$. 5. *Chalcidolepis metallicus* $\frac{1}{2}$



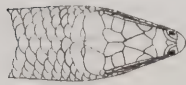
1. Basiliscus plumifrons. 2. B. mitratus.



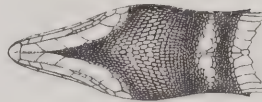
R. Sinclair & Son. Lith. Phila.

1. *Dendrophidion melanotropis*. 2. *Dryiophis brevirostris*. 3. *Hyla elæochroa*. 4. *Hylodes cerasinus*.

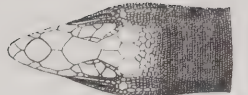




1



3b



3a



2a



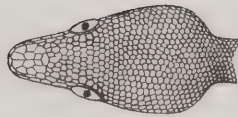
2b



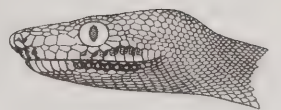
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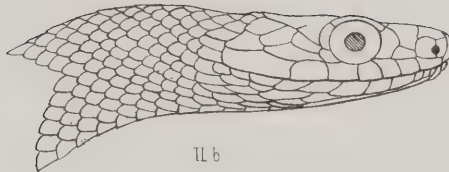
5



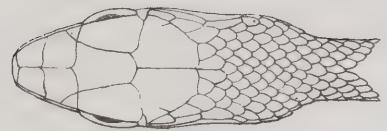
6a



6b



11b



11a



7



9a



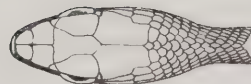
9b



8b



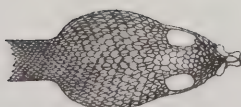
8a



10a



10b



13



12a



12

1. Mabuya alliacea. 2. Chalcidolepis metallicus. 3. Amiva gabbiana. 4. Anolis trochilus. 5. A. oxylophus. 6. Xiphosoma annulatum. 7. Leptognathus argus. 8. L. pictiventris. 9. Leptophis æruginosus. 10. L. saturatus. 11. Spilotes chrysobronchus. 12. Contia calligaster. 13. Bothriopsis proboscideus.



MORCH., ON WEST INDIAN SCALIDAE.

Description of Vertebrate Remains, chiefly from the Phosphate Beds of South Carolina.

By Prof. JOSEPH LEIDY.

DURING the past two years the leisure of the writer of the present communication had become so much occupied in another field of investigation that until a few weeks ago he had no idea of doing anything again so soon in the way of palæontological research. The recent great International Exhibition, established in commemoration of the centennial existence of the United States, with a profusion of other matters of interest, has brought to his notice, in the agricultural department of the government building, and in various collections of manufacturing companies of fertilizers, many fossils obtained from the so-called Ashley Phosphate Beds of South Carolina. Among the fossils there are a number of sufficient importance to command attention while the opportunity exists of examining them, for in most cases they are likely to be lost to the inspection of students after the great exhibition closes.*

Want of sufficient time and the means of making the requisite comparisons have prevented the determination and description of the greater number of the fossils, especially of the numerous Cetacean vertebræ, and the teeth of Sharks, wonderful for their multitude and variety as some of them are for their size. So much uncertainty and confusion prevail in the reference of teeth of extinct Sharks to genera and species, that until some one who has the opportunity will afford us the means of making comparisons by publishing good figures of the entire series, in all its varieties, of the dentition of the living Sharks, we cannot hope to give a satisfactory account of the fossil teeth.

The Ashley Phosphate Beds, as they are commonly called, of South Carolina, now extensively explored for their stores of fertilizing materials, are composed of sands and clays, intermingled with irregular porous masses of more coherent rock rich in calcium phosphate, together with many organic remains. These beds, the economical importance of which was fully made known in 1868 by Prof. Francis S. Holmes and Dr. N. A. Pratt, of Charleston, occupy a large extent of country in the southern part of South Carolina, on the Wando, Cooper, Ashley, Stono, Edisto,

* The finder and unscientific owner of fossils, ignorant of their real importance, often retain them as curiosities, with exaggerated notions of their pecuniary value, and no argument is sufficient to induce them to part with the specimens or place them where they may be accessible to the student.

Coosaw, Asheepo, and other rivers. According to Prof. Holmes, from "fifteen to eighteen inches may be considered the average thickness of the stratum of the phosphate rocks."*

The exact stratigraphical relations of the beds and the relative age of these and contiguous strata have not been as thoroughly investigated as is desirable, and in many cases the particular horizon to which belong the fossils that have been discovered has not been positively determined. According to Prof. Holmes the phosphate beds are of the post-pliocene period and overlie strata pertaining to the pliocene period, and these are again succeeded by a soft marl rock of eocene age, the whole being covered by modern alluvium.

The phosphatic rocks, or nodular masses of the phosphate beds, said to contain as high as 60, or even more, per centum of calcium phosphate, are of irregular shape, and range in size from small pieces up to masses of a thousand pounds or more.† They contain many casts of molluscous shells, which appear to be of the same forms as those which occur in the eocene or miocene marl rock beneath. They also frequently contain imbedded bones and teeth, mainly those of marine Fishes and Cetaceans.

The phosphatic nodules are supposed to have been derived from the tertiary marl bed beneath, and are considered to be detached and altered fragments from the surface of that bed. The irregular, eroded, and porous masses have the appearance of being detached and water-rolled fragments of the tertiary marl rock after it had been tunnelled by various boring mollusks. It is, indeed, not improbable, as has been suggested, that in the later part of the eocene or miocene period and subsequently the easily penetrated rock was bored and rendered spongy by the incessant labors of multitudes of *Gastrochæna*, *Petricola*, *Pholas*, etc. At the time or later, neighboring and superficial islets, the resorts of myriads of sea fowl, may have furnished the material which, when washed with the ocean and mingled together with the decomposing remains of marine animals, supplied the element for conversion of the porous marl rock into the more valuable phosphatic compound.

Besides the phosphatic nodules, the Ashley beds present a remarkable intermixture of the remains of marine and terrestrial animals, consisting of bones, teeth, coprolites, shells, etc., derived from the contiguous formations of various ages from the early tertiary to those of a comparatively recent period.

Of remains of Vertebrates, those of Fishes and Cetaceans prevail, especially the teeth of Sharks and the vertebræ of Whales. Less frequently there occur the ver-

* The Phosphate Rocks of South Carolina. By Francis S. Holmes, A.M. Charleston, 1870, p. 70.

† A nodular mass, on exhibition in the Government building, from Charleston, S. C., weighs 1150 pounds.

tebræ and teeth of large teleost Fishes, the dental pavements of Rays, fragments of Turtle shells, vertebræ of Crocodiles, ear-bones and teeth of Cetaceans, bones of Manatees, etc. With these likewise are found the remains of both extinct and still existing terrestrial mammals, especially teeth and bone fragments of Elephant and Mastodon, Megatherium, Horse, Tapir, Bison, and Deer. More rarely there are found remains of Hipparion, Castoroides, Hydrochærus, and of the smaller and more common genera and species.

The fossils mainly consist of the harder parts of the skeleton and of teeth, usually more or less water-worn, indicating shallow seas and an active surf to which they were exposed. Many of them exhibit the drilling effects of boring mollusks, especially those which are supposed to have been derived from the tertiary marl rock, the operation of drilling apparently having been performed both before and during the time the fossils were imbedded in the rock. Only enamel or the enamel-like dentinal layer such as is found investing the crown of the teeth of Sharks, appears to have been a protection against the drilling power of the borers.

Fossils excavated from the phosphate beds are of a ferruginous brown color, but often much lighter or white upon the surface. Those which are obtained from the rivers contiguous to the beds are usually more or less black, with the enamel of teeth iron-gray, and they frequently exhibit the basal attachment of small barnacles, and occasionally the valve of an oyster.

From the fossils consisting mainly of the harder and denser, and therefore heavier parts of skeletons and teeth, they are generally assumed to be petrified, but usually the change has not been more than a moderate loss of the ostein basis and the infiltration of iron oxyd.

From the extraordinary variety and profusion of the fossil remains of the Ashley phosphate beds it may be inferred that these were the former rich feeding grounds for multitudes of marine and amphibious animals. At an early period during the formation of the tertiary marl, here congregated great Sharks, Rays, Squalodons, etc. At a later period their successors varied their diet with the carcasses of great land animals, as Elephants, Mastodons, etc., which floated down the broad and swollen rivers, as drowned herds of the Bison are said to do in our day upon the Missouri River.

Some of the remains of terrestrial animals, comparatively few in number, found as fossils in the Ashley phosphate beds, including even the softer or more spongy bones, exhibit no evidence of violent water action other than the signs of decay from the combined influence of moisture and air; neither do such fossils exhibit the marks of boring mollusks, nor the attachments of barnacles. Usually black

and more or less friable, these fossils, such as the bones of Mastodon, Megatherium, Deer, etc., are no doubt the remains of animals which became mired and sunk into marshes of the Ashley phosphate beds after these had become elevated above the surface of the neighboring sea. Of this nature also, we may believe, are the remains of more recent animals, including also specimens of human bones, those of domestic animals, and stone implements, which are occasionally found in the Ashley phosphate beds.

EQUUS.

Molar teeth of Horses apparently referable to the two species which have been named *Equus major* s. *complicatus* and *E. fraternus*, are among the more frequent remains of terrestrial mammals found in the Ashley deposits. The different collections of materials from the latter displayed at the International Exhibition contain a number of specimens of teeth. The lower molars of both named species and the upper ones supposed to pertain to *E. fraternus*, present nothing distinctive from the corresponding teeth of the recent Domestic Horse; so that some of the specimens no doubt really pertain to the latter. The additional specimens of teeth from the Ashley deposits which I have seen, give no further information than those which have been described and figured in Holmes' Post-pliocene Fossils of South Carolina.

HIPPARION.

HIPPARION VENUSTUM.

Leidy: Proceedings Academy of Natural Sciences of Philadelphia, 1853, 241.

Hippotherium venustum, Leidy: Holmes' Post-pliocene Fossils of South Carolina, 1860, 105, Pl xvi., figs. 32, 33.

Of *Hipparion* I have seen no other specimens, though I have industriously searched for them in the different Ashley collections, except those described and figured in Holmes' Post-pleiocene Fossils of South Carolina under the name heading this paragraph.

ELEPHAS.

ELEPHAS AMERICANUS.

Dekay: Nat. Hist. New York; Zoology, 1842, I., 101.

Remains of the American Elephant, chiefly molar teeth or fragments of the same, consisting of isolated enamel plates or several conjoined by the more or less decomposed intervening cementum, are frequent fossils of the Ashley phosphate

beds. An entire well-preserved molar, the last of the lower series, from the property of the Marine and River Mining Company at Beaufort, S. C., is contained in the Ashley collection of fossils of the Smithsonian Institution at the International Exhibition. Most collections of Ashley fossils of moderate extent contain fragments of Elephant molars, but rarely of bones.

All the specimens of molars from the Ashley beds which I have had the opportunity of inspecting, belong to the coarse plated variety, which Dr. Falconer referred to a species distinct from the *Elephas primigenius*, under the name of *E. columbi*. For reasons elsewhere given I have been disposed to consider most of the Elephant remains of North America, including molar teeth with comparatively thin plates, as pertaining to a common species under Dekay's name heading the present article.

MASTODON.

MASTODON AMERICANUS.

Leidy: Proceedings Academy of Natural Sciences of Philadelphia, 1868, 175.

Remains of the common American Mastodon, principally consisting of molar teeth and fragments, together with portions of tusks, are of frequent occurrence among the Ashley fossils. The Smithsonian collection of the latter at the International Exhibition, besides fragments of teeth, contains a well-preserved last inferior molar from the Coosaw River.

Besides remains of the former species, from the same beds, I have seen small fragments of molar teeth such as I have considered to pertain to another species under the name of *Mastodon obscurus*. Several such fragments of upper molars are contained in the collection of the Pacific Guano Company.

MEGATHERIUM.

Remains of the Megatherium are occasionally found in the excavations of the Ashley phosphate beds. In Holmes' Post-pliocene Fossils of South Carolina, 1860, page 111 (Pl. xx., fig. 8), a notice is given of fragments of teeth from this locality. The collection of the Pacific Guano Company contains a well-preserved specimen, represented in figs. 42, 43, Pl. xxxiv., consisting of the upper part of a tooth, the first of the series of the left side of the lower jaw. It accords in form, proportions, and size sufficiently near to the corresponding tooth of a cast in plaster of the lower jaw from the skull of *Megatherium americanum*, preserved in the British Museum, to belong to the same species.

A fragment of the lower extremity of a femur of the Megatherium from the

Ashley phosphate beds was recently presented to the Academy by Mr. George T. Lewis. It comprises a portion of the shaft with one condyle and the trochlea of the patella, and accords in size and other characters with the corresponding portion of the same bone in the South American *Megatherium*. What remains of the specimen is well preserved, but is not petrified. It is black, like the tooth above described, but is not water-worn, nor does it exhibit any of the marks of boring mollusks or attachments of others, so frequent among the marine fossils of the Ashley beds. It perhaps belonged to an animal which became mired and perished when the Ashley beds were elevated above the sea level and formed marsh lands.

MANATUS.

MANATUS ANTIQUUS.

Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1856, 165; Holmes' Post-pliocene Fossils of South Carolina, 1860, 117, Pl. xxiv., figs. 5-7.

The collection of Ashley fossils, of the Pacific Guano Company, contains many remains of a Manatee, consisting mainly of rib fragments, mutilated vertebræ, and fragments of skulls, but none are sufficiently characteristic to determine positively whether they indicate a species different from its existing representative living further south. Among the specimens there are four which consist of that part of the skull formed by the summit of the occiput and the contiguous portions of the parietals. These, though exhibiting trifling variation, are yet sufficiently like the corresponding portion of the skull of our recent Manatee to belong to the same species.

A tooth of a Manatee from the same locality described and figured by me in Holmes' Post-pliocene Fossils of South Carolina, is sufficiently distinctive to pertain to a species different from our recent one, and it is probable that the bones above indicated may belong to the same species as the fossil tooth, with which they accord better in their larger size.

ROSMARUS.

ROSMARUS OBESUS.

s. *Trichecus rosmarus*.

The present southern limit of the Walrus on our coast is the northern part of Labrador. A century ago the animal existed among the Magdalen Islands in the Bay of St. Lawrence, and even as far south as Sable Island, Nova Scotia; but in these localities it has been completely exterminated. Remains, discovered at different points along the coast, have been described or referred to, indicating the further extension of the animal at an earlier period as far south as Virginia.

No remains of an undoubtedly extinct species known to me have been discovered anywhere. Dekay (Nat. Hist. New York, Zoology, I., 1842, p. 56, Pl. xix., fig. 1) notices a specimen, consisting of the facial portion of a skull of a Walrus, found on the shore of Accomac Co., Virginia, which he refers to an extinct species with the name of *Trichecus virginianus*. He gives as its characters: "Cheek teeth with obliquely truncated crowns, not ridged; the second smaller than the first." These apply to the recent animal as well, and therefore do not justify the reference of the specimen to an extinct species.

Among the collection of Ashley fossils of the Pacific Guano Co., submitted to my inspection by Mr. J. M. Gliddon, there is a specimen of a Walrus tusk with perhaps sufficient peculiarity to infer a species different from the living one, though I suspect the peculiarity is of an individual varietal, and perhaps partly of an accidental character.

The specimen, represented one-third the natural size in figure 6, Pl. xxx., is as black as ebony; dense, heavy, and brittle, and has been broken by an accidental blow of the shovel into a number of pieces. These have been cemented together, and the tusk appears nearly complete, except at the thin border of the pulp cavity. The inner curvature is slight, and it indicates the tooth to be of the left side.

In robust character the tusk quite equals those of the largest mature recent skulls which have come under my observation, but is much shorter and more abruptly tapering. The specimen looks like what we might suppose the tusks of the living animal would, were they broken off near their middle and then worn away little more than one-fourth the length in a curved line deflected from the course of the anterior longitudinal convexity to the tip. The comparative brevity of the tusk and its worn condition at the end may perhaps have depended on just such an accident and subsequent wear.

In a mature skull obtained from the shore of Sable Island, and preserved in the museum of the Academy, the tusks, which are of the usual size, are worn in the same manner as in the Ashley specimen for more than half their length.

The inner side of the Ashley tusk is fluted in front and behind the middle. The intermediate ridge is the most prominent, and the posterior ridge is further defined by a groove descending and disappearing before reaching the middle of the tusk. The outer side of the fossil is also fluted, though not so conspicuously, and the furrows disappear below the middle of the tusk. The arrangement on the inner side of the specimen resembles that on the outer side of a large pair of tusks in a mature recent skull, contained in the collection of the Academy, more than it does that on the same side of these. The fluted arrangement of the tusks of the

Walrus is, however, subject to variation, and cannot, as far as relates to the condition observed in the fossil, be considered of specific value. Variation in the exact arrangement of the fluting is exhibited in the tusks of the Sable Island skull above mentioned, and in those of a skull found in Monmouth Co., New Jersey, also contained in the collection of the Academy.

While we cannot consider the characters presented by the fossil tusk as of sufficient value to determine positively whether it pertained to a species of Walrus distinct from the living one, it is an interesting fact to have learned that this or a closely related species formerly existed so far south as the Ashley River, South Carolina.

The length of the tusk following the curve externally is 13 inches; near the root fore and aft it measures $3\frac{1}{2}$ inches, and transversely $1\frac{1}{2}$ inches; at the middle about the same fore and aft, and $2\frac{1}{2}$ inches transversely.

DINOZIPHIUS.

DINOZIPHIUS CAROLINENSIS.

Teeth not differing from those of the recent Sperm Whale have been discovered in the Ashley phosphate beds. Two such teeth are indicated and described in Holmes' Post-pliocene Fossils of South Carolina. In the Ashley collection of fossils of the Pacific Guano Co. there is a large tooth, which from its form I infer to have belonged to a species different from the recent one, and it is not improbable that it may have pertained to a huge Ziphoid Cetacean.

The specimen represented in figure 6, Pl. xxxiv., one-half the size of the original, is black, dense, heavy, and brittle, but not petrified; and it has the same structure as the teeth of the Sperm Whale. It is fusiform with only slight lateral compression, and is nearly straight or feebly curved. It is most robust at the upper third or crown, and is in this position blunt, conical, and devoid of any trace of enamel. The fang is an elongate cone with a small funnel-shaped pulp cavity at the apex less than an inch in depth.

In size and form the specimen resembles certain large teeth from the Antwerp crag, such as are represented in the magnificent "Osteographie des Cétacés" of Van Beneden and Gervais, Pl. xx., figs. 29-32, under the names of *Dinoziphius Raem-dorkii* and *Eucetes ambliodon*, which Prof. Gervais regards as the same. As the animal to which the Ashley fossil tooth pertained lived in the same ocean and may have been contemporary with those animals to which the Antwerp crag teeth belonged, it is not improbable that all were of the same species.

The length of the tooth is $8\frac{1}{4}$ inches; its greatest diameter, three inches from the summit, is $3\frac{3}{16}$ inches, and the lesser diameter in the same position is $2\frac{7}{8}$ inches.

CETACEAN TEETH.

A specimen of a tooth resembling those of the Sperm Whale, represented in figure 7, Pl. xxx., was derived from the Ashley phosphate beds. It is nearly complete, except at the lower extremity, where it exhibits the summit of a conical pulp cavity. It is slightly curved, slightly compressed cylindroid below, and blunt conical at the free end. It is furnished with a thin layer of cementum, through which the dentine protrudes at the end of the crown. In portions deprived of the cementum the circular lines of growth of the dentine are quite obvious. In its present condition the tooth is about $4\frac{1}{2}$ inches long; its greatest diameter below is 16 lines; its shorter diameter in the same position, 15 lines.

Another specimen, represented in figure 8, Pl. xxx., from the same beds, in its complete state, was a little larger than the former. The fang is solid to the broken extremity, and the end of the crown was worn all around into a cone with the apex directed inwardly. The tooth appears nearly straight and cylindric throughout the greater part of its length. The cementum is broken away, except a portion internally, where it is $2\frac{1}{2}$ lines thick. The exposed dentine conspicuously exhibits the circular lines of growth. The specimen in its present condition is $3\frac{1}{2}$ inches long.

A small tooth, represented in figure 9, Pl. xxx., from the Ashley beds, is black, dense, and lustrous. It has the end of the fang and crown broken off, and is smooth and water-worn, which the former specimens appear not to be to any marked degree. The tooth is oblique in its axis instead of appearing curved. The fang is rounded trilateral, and exhibits thick circular striæ of growth. The crown is conical and defined from the root. Its surface is smooth, shining, and feebly striate longitudinally, and it has an indistinct appearance of being invested with a thin enamel layer, though I have been unable to determine positively whether such exists. The specimen in its present state is $1\frac{3}{4}$ inches long; the diameters at the base of the crown are 8 and 7 lines.

This tooth bears some resemblance to one from the Red Crag of Suffolk, England, represented in fig. 23, in a paper of Prof. Owen, in the Quarterly Journal of the Geological Society of London for 1856. The Red Crag tooth is referred by Prof. Owen to a *Grampus*, *Phocæna*.

A mutilated Cetacean tooth, represented in figure 10, Pl. xxx., is from the miocene marl of Nash Co., North Carolina, and was presented to the Academy by Dr. O. D. Coppedge. It is curved cylindroid, with the root flattened on the inner side. The crown has had a cap of its dentine broken away, and in its present

condition is conical. The surface of the fang exhibits strongly the concentric edges of the dentinal layers composing the tooth, which perhaps have been thus rendered so conspicuously evident by the eroding action of the ocean water. The end of the fang presents a shallow half conical pulp cavity. The specimen in its present state is less than three inches long, and 10 lines by 9 lines in its thickness.

Figure 11, Pl. xxx., represents what appears to be a small Cetacean tooth, found with the preceding specimen in the marl of Nash Co., N. C. It is solid throughout, the lower extremity having been broken squarely off. It is curved cylindrical with a worn conical point. It appears to be devoid of a cemental layer, and below the conical summit exhibits a close series of circular striæ of the dentinal laminæ. The length of the specimen is 14 lines; its thickness, $2\frac{1}{2}$ lines.

ZIPHIROID CETACEANS.

The Ziphioid Cetaceans, of which remains appear to be frequent among the fossils of the South Carolina phosphate beds, belong to the sub-order of the Odontocetes, or Toothed Whales, although they are almost destitute of the organs from which these are named. They have no functional teeth in the upper jaw, and with the exception of one, or at most two pair, they are absent in the lower jaw. The rostrum or forepart of the skull is elongated and remarkable for its dense ivory-like character, which often leads detached fossil specimens to be considered as being petrified.

CHONEZIPHIUS.

The genus *Choneziphius*, to which I suppose several of the Ashley fossils belong, is thus characterized by Prof. Gervais:—Independently of the form of the rostrum, in which the intermaxillaries are co-ossified at their internal border and the maxillaries are so united inferiorly as to permit only a narrow portion of the vomer to be seen, the genus is also distinguished by the want of ossification of the supra-vomerine cartilage, the absence of which leaves a fistulous excavation extending the length of the rostrum. Interocular space broad and flattened; a pair of infundibuliform fossæ occupying the region near the external nares, with the right fossa much larger than the left, and each ending in a vascular foramen which penetrates the rostrum by extending into the intermaxillaries.

CHONEZIPHIUS TRACHOPS.

Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1876, 81.

The species is indicated by a specimen found in the Ashley phosphate beds worked by the Pacific Guano Co., and is represented in fig. 2, Pl. xxx., and fig. 1,

Pl. xxxi. It consists of the rostral portion of the skull of a Ziphioid Cetacean, detached in the position of the nasal passages. The end of the beak is lost and a portion of the anterior extremity of the intermaxillaries is broken away, so as to expose half the length or more of the vacant supra-vomerine canal.

In its present state the specimen measures twenty-one inches in length. All the bones entering into its composition, consisting of maxillaries, intermaxillaries, and vomer, are completely co-ossified, so that it is difficult to assign to the different ones their exact limits. The fossil is almost ivory-like in density and very heavy, as usual with the rostrum of most members of the family. The condition of ossification in its solidity resembles that of the bones of the Walrus and Manatee, and as in these, often misleads persons to consider the state to be due to petrification.

The specimen, like most of the Ashley fossils, is water-worn, and in many places exhibits the boring effect of such mollusks as *Gastrochæna*, *Petricola*, etc. It likewise presents a number of attached basal plates of small barnacles, apparently of more recent date than the borings of the mollusks.

In most respects the specimen bears resemblance to a nearly corresponding one from the crag of Antwerp, originally described and figured by Cuvier (Ossements Fossiles, T. 8, p. 245, Pl. 228, fig. 7) with the name of *Ziphius planirostris*, and subsequently referred to another genus by Duvernoy (An. Sc. Nat. 1851, 43), under the name of *Choneziphius*. Good figures of the same specimen are given in the Ostéographie des Cétacés, by Van Beneden and Gervais, Pl. xxvii., fig. 5, with which those of our figures in Pl. xxx. and xxxi, reduced to the same scale, may be compared.

The specimen viewed from above, fig. 2, Pl. xxx., presents a long narrow triangle with an expanded base corresponding with the interocular or prenasal region. The sides of the triangle in converging towards the end of the beak, present a slight swell outwardly near the middle, but they are not exactly symmetrical.

The unequal and unsymmetrical prenarial fossæ occupying the median portion of the interocular space of the cranium are moderately concave, compared with their condition in *Choneziphius planirostris*. Shelving downward and forward from their broadest position bordering the nasal orifices, they converge in a funnel-like manner into a pair of grooves extending along the upper part of the beak in the line of junction of the maxillaries and the intermaxillaries. The right prenarial fossa is very much larger than the left one, measuring at its widest part three and three-quarter inches, while the latter in a corresponding position is only a little over two inches wide. Externally the prenarial fossæ are defined by a curved ridge, which appears to form the outer border of the intermaxillaries.

Just in advance of the nares they are separated by an irregular notch narrowing forward into a shallow irregular groove, about two inches long, which apparently indicates the original sutural disconnection of the intermaxillaries. The notch is partially occupied by a thin ridge which appears to be an extension of the nasal partition or mesethmoid bone.

The grooves proceeding forward from the prenarial fossæ, about seven inches in advance of the nares, are somewhat constricted, and just preceding this constriction the prenarial grooves communicate each with a large intermaxillary foramen continuous with a canal descending forward within the intermaxillary bone.

The median position of the beak between the prenarial grooves is occupied by a prominent ridge formed apparently by the union of the two intermaxillaries. The forepart of this ridge in the specimen is broken away, leaving exposed to view the supra-vomerine canal, extending forward as a deep groove to the end of the beak. The intermaxillary ridge widens at its summit in passing backward and forms an unsymmetrical clavate prominence, bending to the left, between the position of the prenarial fossæ. The posterior rounded extremity of the ridge is continuous with the irregular elevated borders of the groove separating the back part of the prenarial fossæ, and the groove just mentioned is continuous with a short fissure upon the intermaxillary ridge. The latter, if I am not mistaken, is considered by Prof. Owen as pertaining to the prefrontals, and not to the intermaxillaries; the prefrontals being, as I understand the matter, homologous with the narial septum and the mesethmoid cartilage when this exists in this condition. The intermaxillary ridge, as I have described it, in the fossil, forms the roof of a long canal, made vacant from the destruction of the mesethmoid cartilage, extending from the position immediately in advance of the nasal passages all the way to the end of the beak. If then the cartilage removed from the supra-vomerine canal is regarded as an extension of the prefrontals, the ridge roofing over the canal at the back as well as at the forepart of the beak I would suppose to belong to the conjoined intermaxillaries.

The supra-vomerine canal, for the accommodation of the mesethmoid cartilage, extending throughout the length of the beak, is large and laterally compressed cylindroid, about three-fourths of an inch perpendicularly and half an inch transversely.

The maxillaries on the upper part of the base of the beak, outside the position of the maxillo-intermaxillary groove, exhibit a conspicuous rugged tract, such as is also described and represented to exist in *Choneziphius planirostris*. The two tracts are not quite symmetrical, that of the right side being more developed. The

right one is the wider, and extends further backward and outward, though not so far forward as the left one. The right tract is about six inches long and one and three-fourths wide near its middle.

In another fossil specimen from the same collection, and consisting of a fragment of the right maxillary bone from a larger individual, the corresponding rugged tract is eight inches long and nearly two inches wide.

Back of the rugged tract, in the fossil under special examination, the surface is extended in a broad crescentoid groove, outside the position of the prenasal fossa, forming part of the supra-orbital fossa of the maxillaries. A large foramen just behind the rugged tract opens outwardly into a channel from the anterior division of the infra-orbital canal.

Laterally, the upper surface of the beak is defined posteriorly from the palatine surface by a subacute ridge. This proceeds forward, and near the middle of the beak divides into two branches which, continuing to advance with slight divergence, subside near the end. On the left side the principal ridge advances several inches further than the right, and its branches are less conspicuous. In the fork of the branches a neuro-vascular canal opens forward into a groove which gradually becomes obsolete in front.

In the side view of the beak (fig. 1, Pl. xxxi.) the median intermaxillary ridge appears as its most elevated outline, but at the base the back end of the rough tract of the maxillaries rises nearly to the same level. The lower outline forms a moderate inflection between the end of the beak and the deep antero-posteriorly convex carina intervening to the broad depressed surfaces for the palatines and pterygoids.

Viewed beneath, the back of the beak exhibits a prominent carina with deep sloping surfaces extending to the lateral subacute borders. The deep slopes present broad, shallow, concave depressions for the palatine bones which are separated from the lateral borders of the beak by narrower groove-like concavities.

The median palatine carina is acute just in advance of the inferior nares, becomes obtuse forward, and gradually expands on the transversely convex under-surface of the anterior two-thirds of the beak. The acute portion of the carina is continuous backward with the nasal partition, and its sides are impressed by the pterygoids. This portion of the carina appears to be formed by the vomer, and is the only portion of that bone seen on the under part of the beak.

The anterior two-thirds of the beak beneath form an elongated demi-cone not exactly symmetrical on the two sides. No trace is visible of the original median separation of the maxillaries. The palatine surface near the end of the beak pre-

sents a number of small grooves extending forward from neuro-vascular canals within the maxillaries.

The nasal passages present the usual want of exact symmetry, and are in no wise peculiar. The right one measures an inch and three-fourths transversely, and the left one has a little greater fore and aft diameter. The nasal partition obliquely measures four and a half inches in depth.

The length of the beak in its entire condition, from the upper nares, has been about twenty-two inches. The perpendicular depth, from the posterior expanded extremity of the intermaxillary ridge to the lowest part of the median palatine carina, is four and three-quarter inches. The width of the beak, on a line with the anterior wall of the nasal passages and just outside the prenasal fossæ, is six and a half inches.

A section of the anterior extremity of the beak, across the exposed supra-vomerine canal, is transversely oval, with the left pole flattened and the upper part deeply notched, with the edges of the notch projecting upward. On each side of the notch there is a foramen directed from a canal extending parallel with the vomer, but situated between the maxillaries and the intermaxillaries.

CHONEZIPHIUS LIOPS.

Choneziphius leiops, Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1876, 81.

A second and smaller species of Ziphioid Cetaceans, which may be regarded as of the same genus as the former, is indicated by another specimen from the same collection of fossils. It also consists of a muzzle detached from the cranium, and is represented in fig. 1, Pl. xxx. and fig. 2, Pl. xxxi. Like its associate, ascribed to *C. trachops*, it is exceedingly dense and has all the constituent bones completely co-ossified. Both specimens are brown in hue from ferruginous infiltration, but the one under special consideration is darker, and on freshly fractured surfaces appears black. Its upper part exhibits many holes produced by boring mollusks. The end of the beak is lost, but the specimen retains its supra-orbital processes.

From the ant-orbital notches the muzzle tapers, at first in a curving and then in a straight line, towards the end more abruptly than in the former species, so that the beak did not appear proportionately so long and narrow as in that one.

The co-ossified intermaxillaries cover the supra-vomerine canal except at the fore part of the beak, where it is exposed as a demi-cylindroid groove bounded by acute borders. How much the exposure of the canal is due to loss of a portion of the intermaxillaries, cannot be determined; but if the sharp edges of the groove are the natural condition, the loss has been small.

The supra-vomerine canal is cylindroid, slightly compressed laterally, and is about five-eighths of an inch in vertical diameter and half an inch transversely.

The conjoined intermaxillaries, where they cover the supra-vomerine canal, form an acute ridge expanding posteriorly in a long narrow triangular elevation with an irregularly rounded base bent unsymmetrically towards the left, and producing a central prominence to the prenarial or interorbital region. From the fore part of the intermaxillary eminence the sides of the rostrum slope forward and outward nearly evenly to the lateral borders of the beak. From the posterior expanded extremity of the intermaxillary eminence a groove extends to the nasal orifices, separating the prenarial fossæ. These have the same form as in *C. trachops*, and in the same manner converge forward into grooves extending along the beak, but in the fossil under consideration the grooves unite across the acute fore part of the intermaxillary ridge, about eight inches in advance of the nares. The grooves in their course, as in *C. trachops*, communicate with a large foramen continuous with a canal extending into the intermaxillary bone. The right prenarial fossa is larger and deeper than the left one, being about three and a quarter inches wide, while the latter is about two inches wide. The groove from the left fossa is partially overhung by the expanded base of the intermaxillary eminence.

Outside of the position of the prenarial fossæ the supra-frontal expansions of the maxillaries present another pair of deep curved fossæ, which converge forward and disappear upon the sloping sides of the beak. The left supra-orbital fossa is both deeper and wider than the right one. In front and behind, a pair of strongly marked vascular grooves, curving outwardly in opposite directions, communicate by a pair of foramina from the supra-orbital fossa, internally with the infra-orbital canal. Externally the supra-orbital fossæ are bounded by thick arched elevations of the maxillaries. The left supra-orbital eminence is conspicuously larger than the right one. The anterior orbital notches are wide, but shallow.

The lateral subacute border of the rostrum continues undivided to the anterior broken end of the beak. Near the middle of its course a vasculo-neural canal opens into a groove proceeding forward. On the left side, the lateral border of the rostrum bifurcates in advance of its middle into a pair of branches which extend forward widely separated. A vasculo-neural canal corresponding with that just mentioned, opens in the crotch of the dividing border.

The under part of the rostrum resembles in its construction the same part in *C. trachops*, but proportionately is more expanded posteriorly. From the posterior carina, separating the palatine articulating surfaces, a slight median ridge or line advances on the beak and disappears. No other mark than this line exists indicating the original separation of the maxillaries.

Just behind the palatine articular impression externally is seen the usual open part of the infra-orbital canal with its branches extending to the supra-orbital fossa.

The nasal passages present the same character as in *C. trachops*. The right one appears to have been slightly the wider, while the left appears to have had a greater fore-and-aft extent.

The length of the fossil in its present condition is a little over a foot from the anterior nasal orifices. When entire it has been about fourteen inches long. The breadth at the supra-orbital eminences is about eleven and a quarter inches. The depth of the base of the rostrum from the expanded extremity of the intermaxillary ridge to the palatine carina, is three and seven-eighths inches.

EBOROZIPHIUS.

EBOROZIPHIUS CÆLOPS.

Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1876, 81.

Another specimen from the Ashley River collection of fossils belonging to the Pacific Guano Co., represented in fig. 5, Pl. xxx., and fig. 3, Pl. xxxi., likewise consists of the detached muzzle of a Ziphioid Cetacean apparently pertaining to a genus different from the foregoing and others previously described. It possesses the same ivory-like density of the preceding specimens, and as in them, all the constituent bones are completely co-ossified. Unlike the others, it is white on the surface, with pale brown in freshly fractured places. The specimen has lost the supra-orbital processes of the maxillaries, and the end of the beak for several inches is otherwise mutilated and considerably water-worn. In its present condition it is fifteen and a half inches in length. It pertained to an animal about the size of *Choneziphius trachops*, but the muzzle appears to have been less narrowed in front.

The inferior or palatine part of the specimen presents nothing strikingly different from that of the preceding specimens, referred to *Choneziphius trachops* and *C. liops*, but the upper part is sufficiently peculiar to have led me to ascribe the fossil to a different genus with the name above given.

The intermediate portion of the rostrum above forms a wide gutter, bounded on each side by a thick elevated tuberosity nearly occupying the position of the conspicuous rugged tract of the maxillaries of *Choneziphius trachops*. The maxillary tuberosity on the inner side is convex from behind forward. Its upper surface, slightly concave, slopes from a curved acute ridge, defining it from the inner side, forward and outward to the lateral acute border of the rostrum. In front, the tuberosity subsides and is continuous with a slight ridge advancing upon the

beak a short distance internally to its lateral border. Behind, an acute ridge descends from the highest point of the tuberosity and curves outward and backward towards the position of the supra-orbital roof.

The two maxillary tubercles are not quite symmetrical in size, shape, or position. The right one appears to have been rather the higher, and it extends further back than the left one, but not so far forward. Behind the tubercles, the wide hollow of the muzzle turns outwardly into a deep groove directed towards the position of the supra-orbital roof. Opening into the groove is a large foramen continuous with the anterior division of the infra-orbital canal, which opens behind on the fractured border of the fossil.

The broad deep hollow of the upper part of the muzzle is but feebly divided by the conjunction of the intermaxillaries. These form no conspicuous rising above the supra-vomerine canal such as exists in *Choneziphius*. Posteriorly, in the prenarial region, the intermaxillaries are separated by a deep notch or wide fissure terminating forward and communicating below with the back portion of the supra-vomerine canal. The latter anteriorly is exposed for more than half its length by the destruction of the upper fore part of the intermaxillaries. The canal is elliptical in transverse section with subacute poles, and is about an inch from above downward, and five-eighths of an inch transversely.

Outside the position of the vomer, in the specimen, on each side portions of a vasculo-neural canal are exposed by the breaking away of the intermaxillaries which in the complete condition covered them.

The position of the right prenarial fossa, as presented in the two species of *Choneziphius* above described, in the fossil under consideration, is occupied by a thick discoid plate, with an uneven surface, which reminds one of an exostosis.

The left prenarial fossa is concave and not occupied in the manner of the right fossa. It looks as if it had been dispossessed of a similar protuberance, though no traces of fractures are visible indicating the actual existence of such a plate.

The lateral margins of the rostrum posteriorly, converging from the position of the supra-orbital processes, are acute. Anteriorly, in the specimen, they are mutilated, but they exhibit evidences of having divided into a pair of less prominent ridges proceeding forward towards the end of the beak. The wide, shallow, concave surface between the ridges presents a vascular groove proceeding forward from a canal in the maxillary bone.

The estimated length of the muzzle from the nares is about twenty inches. The depth or thickness of the base, just in front of the prenarial fossæ, is about

three and a half inches. The width between the outlets of the anterior branches of the infra-orbital canals in the supra-orbital fossæ is nearly six inches.

In the broad deep hollow of the upper back part of the rostrum bounded by the stout maxillary crests, the fossil bears a striking resemblance to the corresponding part of *Hyperoodon*. In this, however, the intermaxillaries remain distinct in the median line, and neither of them exhibits the curious exostosis-like development of the right prenasal fossa. Further, in *Hyperoodon* the high lateral maxillary crests are crescentoid in an opposite direction—that is to say, they have their convexity outward instead of inward.

DIOPLODON.

DIOPLODON PROROPS.

Belemnziphius prorops, Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1876, 81.

The beak of a Ziphioid Cetacean, represented in figures 3, 4, Pl. xxx., from the Ashley River phosphate beds, was presented to the Academy by Mr. C. S. Bement. It indicates a fourth species of a genus, differing from the preceding; and pertained to a smaller animal than any of the others. The specimen has the same ivory-like density and is of a ferruginous brown hue. All the constituent bones are co-ossified, as in the previous specimens, and in addition, the mesethmoid cartilage is ossified and fused with the surrounding bones, so that the beak is solid throughout and exhibits no trace of a supra-vomerine canal, except perhaps at the back part of the fossil. In the complete solidity of the rostrum it accords with the character in this respect of the genus *Dioplodon* of Gervais, or the *Belemnziphius* of Huxley.

The specimen in its present condition, in the median line, is about eight inches in length, and apparently less than an inch has been lost from the point. Viewed from above, fig. 3, the outline forms an isosceles triangle with the sides curving inwardly, but bulging a little near the apex. Viewed laterally, fig. 4, the upper outline from the root forward appears convex with an irregular deflection from the middle to the tip of the beak. Underneath, the line from the root forward presents a series of three concavities successively diminishing in length and depth. The conjunctions of the concavities form intermediate points, of which the posterior one is the more prominent and occupies a central position of the rostrum.

The upper part of the rostrum forms a median ridge from which the surface slopes off to the lateral borders. The ridge is formed by the union of the intermaxillaries, but it exhibits no trace of their original separation. The back part

of the ridge is the more prominent and thick, and is convex and smooth. Its anterior part is as it were cut away on each side, leaving a narrower median extension forward. At the back part of the rostrum the intermaxillary ridge verges on a wide shallow notch, communicating posteriorly and beneath with a deep fossa. The latter appears to be an unoccupied portion of the usual supra-vomerine canal. It widens in a triangular manner below to the broken floor of the vomer, and on each side is bounded by a broken ridge which appears to be the downward extension of the intermaxillary. Four pits, apparently the commencement of vascular canals, are directed forward from the fossa into the rostrum. Two of the pits form a pair below, the others are placed in the median line above the former.

On each side of the upper back part of the rostrum there is a foramen communicating with a vasculo-neural canal directed downward and forward within the intermaxillary bone. The two foramina are an inch and three-eighths apart.

The right lateral margin of the rostrum is acute. The left margin is obtuse and subsides forward. Above the margins a foramen opens from a canal directed forward in a groove. The foramen on the right is an inch and three-eighths behind that of the left side.

The inferior surface of the rostrum presents three pairs of concave facets separated by a median carina which is produced into a central prominence. The pairs of facets successively decrease and become more shallow from behind forward. The posterior largest pair appear to be the palatine articular surfaces. Vascular foramina and grooves leading from them are seen in various positions of the under surface of the rostrum.

At the posterior broken border of the specimen a large foramen is observed communicating with a canal directed inward and forward within the maxillary bone.

The estimated length of the beak in its entire state from the nasal notch is eight and a half inches. The depth or thickness at the notch back of the intermaxillary ridge is an inch and seven-eighths. The distance between the most prominent portion of the intermaxillary ridge and the central eminence of the palatine carina is two and a half inches.

PROROZIPHIUS.

PROROZIPHIUS MACROPS.

Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1876, 87.

Since writing the preceding account, and presenting at a meeting of the Academy a notice of the remains referred to four species of Ziphioid Cetaceans, I have

met with another specimen indicating a fifth member of the same family. In a visit to the Centennial International Exhibition, in one of the cases belonging to the Smithsonian Institution, among a collection of fossils from the Ashley River phosphate beds, I observed the specimen to which I allude. Having made application for its use, it was at once obligingly loaned to me by Mr. W. P. Blake, the gentleman in charge.

The specimen, represented in figs. 1, 2, Pl. xxxii., like the foregoing, consists of the detached rostrum in advance of the nares, but is better preserved at the point. In the present condition it is about two feet in length; and it indicates an animal not only larger than any of those to which the other specimens pertained, but with the exception of the *Hyperoodon*, one of the largest of its kind. The bones of which it is composed are completely co-ossified, so as to leave barely a trace of their original separation, and the specimen is of the usual ivory-like density. The supra-vomerine canal is open throughout, but is exposed only for a few inches at the end.

The beak is long and narrow, with the sides more nearly parallel than in the previously described specimens. The basal half is prismoid with the upper surface remarkably flat, while the anterior half assumes a more conical form. No crest extends along the middle above as in the two rostra referred to *Choneziphius*, nor is there any trace visible of a median groove indicating the original separation of the intermaxillaries.

The lateral borders of the beak posteriorly form a subacute ridge defining the upper nearly flat surface from the inclined palatine surfaces beneath. The ridge extends further forward on the right than on the left, and finally subsides at the conical anterior end of the beak. At the termination of the left ridge there are two foramina, near together, the exit of neuro-vascular canals which open forward into grooves extending anteriorly. On the right there are two corresponding foramina, but one is situated on the lateral ridge several inches behind the other.

The prenarial fossæ appear to have resembled those of *Choneziphius*, being spoon-shaped concavities extending forward into grooves which end in canals penetrating to the interior of the beak.

The left prenarial fossa together with its grooved extension, is longer than the right and wider one. Externally it is defined, by a crescentic ridge, from the supra-orbital fossa. Internally it was separated from the right prenarial fossa by a deep wedge-shaped notch communicating below with the posterior extremity of the supra-vomerine canal.

The prenarial fossæ and the grooves proceeding forward from them define an

unsymmetrical expansion like that of the posterior part of the intermaxillary crest in the rostra attributed to *Choneziphius*. The surface of this expansion is depressed except where it contracts into the ridges bounding the anterior nasal notch.

The end of the beak exhibits on the right side a series of four foramina, the exit of neuro-vascular canals for the passage of maxillary vessels and nerves to the lip and gum. On the left side there are only two of the same kind of foramina.

The supra-vomerine canal where exposed at the end of the beak is ovate in section, acute below and obtuse above. It is over an inch vertically, and about five-eighths of an inch in width.

In the upper view of the beak, fig. 1, the sides at first converge in a curvilinear manner from the preorbital notches, then extend nearly parallel forward to about the middle, when they converge to the rounded point. At the middle, the beak is actually slightly wider than it is some distance back of this position.

In the lateral view of the specimen, fig. 2, at the upper part of the beak, the median line of the base barely projects above the lateral subacute border, and only becomes more prominent as the acute ridge formed by the lateral border descends forward and disappears. The inferior outline proceeds nearly straight forward in advance of the middle and then curves upward to the end of the beak.

The palatine surface posteriorly slopes on each side to a prominent acute carina largely formed by a triangular projection of the vomer. In advance of this it slopes from a median convex ridge, and in front is linguiform.

The rostrum at its middle is $4\frac{3}{16}$ inches wide and $3\frac{3}{8}$ deep; at its anterior fourth is $3\frac{1}{8}$ wide and 3 deep; at its posterior three-fourths is $4\frac{1}{4}$ wide and about $3\frac{1}{2}$ deep.

PROROZIPHIUS CHONOPS.

Another specimen of the beak of a Ziphioid Cetacean, which I observed among a collection of other fossils and phosphatic materials, on exhibition in the Agricultural Department of the Government, from the Ashley beds, worked by the Wando Mining Company, was kindly loaned to me by Mr. H. Amidon.

The beak represented in figs. 3, 4, Pl. xxxii., indicates a species different from any of the foregoing, but appears to be sufficiently like that of *Proroziphius macrops* to belong to the same genus. It has nearly the same form as the specimen ascribed to the latter, but is about one-fourth less in length and is proportionately broader. As in all the other beaks described, the constituent bones are completely co-ossified, while from the non-ossification of the mesethmoid cartilage the supra-vomerine canal remains open and is exposed for about three inches at the end of the beak.

The anterior extremity, comprising nearly half the length of the beak, is conical,

as in *Proroziphius macrops*, but is more prominent above just behind the position of the supra-vomerine canal. In the specimen this portion of the beak exhibits a remarkably eroded appearance, due to the tunnelling of boring mollusks. One of the tunnels makes a communication with the supra-vomerine canal just back of its exposed portion.

The back portion of the beak, in advance of the interorbital region is triangularly prismoid nearly as in *Proroziphius macrops*, but the upper surface is not quite so even. Along the middle, over the position of the conjoined and completely co-ossified intermaxillaries, it is slightly depressed, the depression narrowing forward and ceasing at the median most prominent portion of the beak. On each side of the depressed surface a narrow vascular groove extends forward from a canal opening from the interior of the beak.

The sides of the beak are defined from the inclined palatine surface by a ridge becoming obsolete anteriorly. A pair of vascular grooves extend along the ridge, and beneath its position extending all the way to the end of the beak there is a narrow groove which looks as if it might be the homologue of the alveolar groove in the Porpoises. The trace of a similar groove is observable at the fore part of the beak of *P. macrops*, which would have escaped attention had its much better developed condition not been observed in this.

The right prenarial fossa, preserved in the specimen, is a deep, wide, half funnel-like concavity, not prolonged forward in a groove as in *Proroziphius macrops*, *Choneziphius*, and others, but at once converging into a canal penetrating the beak.

The expansion formed by the conjoined intermaxillaries between the prenarial fossæ does not become so narrowed in its extension backward to the nares as in *Proroziphius macrops*, nor is this extension cleft as in the latter. In *Proroziphius macrops* the cleft just alluded to communicates beneath with the back part of the supra-vomerine canal, but in the beak under description there is no such opening.

The supra-orbital fossa of the right side, as seen in the specimen, presents no special peculiarity.

The length of the beak in the median line from the narial partition to the end is nineteen inches. The width of the beak near the middle is three and one-half inches, and the depth or height in the same position has been about the same measurement.

CETERHINOPS.

CETERHINOPS LONGIFRONS.

A fragment of the skull of a Cetacean, from the Ashley River phosphate beds, in the collection of the Academy, represented in figure 7, Pl. xxxiv., one-half the

natural size, I suspect to belong to a *Squalodont* or to a nearly related genus. It is composed of portions of the frontal, ethmoid, vomer, maxillaries, and intermaxillaries all intimately co-ossified. The specimen is black, moderately heavy, and in several positions retains some portions of soft rock, in which the fossil was once imbedded, and on which are several casts of lamellibranchs, whose characters are too obscure to determine whether they are of miocene or earlier forms. Besides the fossil shells the specimen exhibits a number of attachments of recent barnacles and oysters, indicating that it had been exposed to the action of the present sea.

The specimen as preserved appears bilaterally symmetrical, except so far as the regularity has been disturbed by accident.

The back portion of the vomer exhibits a comparatively capacious groove for the mesethmoid cartilage. The mesethmoid bone forms a thick partition separating the blowholes, and ends in a stout tuberosity at the commencement of the supra-vomerine canal.

The forehead as formed by the frontal is remarkably long fore and aft compared with its usual condition in the Cetaceans. At the occipital boundary it forms a transversely concave line, and the sutural border of the frontal in this position, from the exterior to the cranial cavity, is about an inch in thickness. The fore and aft length of the forehead is two inches, its breadth between the infra-orbital fossæ scarcely $2\frac{1}{4}$ inches. The surface of the forehead is nearly flat, but slightly convex laterally and towards the fore part. The nasals appear to have articulated at the fore part of the frontal and have been detached and lost, though it may be that what I have considered to be the frontal may in part consist of the co-ossified nasals. If the latter view is true, I cannot determine the extent of the nasals as all traces of their outline have been obliterated. The premaxillaries in the specimen appear to have been destroyed so far as to leave the supra-vomerine canal widely exposed. Their posterior part is comparatively narrow where it bounds laterally the blow-holes, and ends in a point extending three-fourths the length of the forehead between the frontal and the expanded supra-orbital portion of the maxillary. Just within the position of the suture defining the premaxillary laterally from the maxillary, a narrow groove extends forward to the broken extremity of the fossil.

The supra-orbital fossæ appear to have been symmetrical, and exhibit nothing unusual. Prenarial fossæ on the premaxillaries can hardly be said to exist.

The under surface of the fossil exhibits the frontal roof of the cranial cavity, together with two holes broken through the ethmoid into the nasal passages. The

latter appear to be about of the same proportionate extent, direction, and symmetry as in the Porpoises.

The co-ossified maxillaries in advance of the lower orifices of the nasal passages form a strong convex prominence, sloping off anteriorly and laterally. No portion of the maxillaries in the specimen contains portions of alveoli for teeth.

EUPACHEMYS.

EUPACHEMYS OBTUSUS.

Remains of turtles are not unfrequent in the Ashley phosphate beds, usually consisting of fragments of the osseous shells, and mostly so small as to yield unsatisfactory results in the determination of the genera and species.

Fragments of the shell apparently of two species of land turtles, one of large size, are indicated and figured in Holmes' Postpliocene Fossils of South Carolina.

The museum of the Academy contains fragments of costal plates of a large species of turtle from the vicinity of Beaufort, S. C.

Prof. Holmes has submitted to my examination a specimen, probably pertaining to the same species as the latter, from the Ashley River, in the vicinity of Charleston. It consists of a marginal bone, represented in figures 4, 5, Pl. xxxiv., half the natural size. I have not had sufficient time and opportunity to determine positively the exact position of the bone in the carapace, but it appears to agree nearest with the eighth of the left side in an *Emys*. The bone is also sufficiently peculiar to have made me uncertain in determining the upper and under surfaces. What appears to me to be the upper surface, fig. 4, rises in a prominent fore and aft ridge just outside of the middle. The inner division of the surface is transversely concave; the outer forms a sloping plane to the external obtuse margin of the bone. The under surface transversely forms a single long convex sweep from the inner to the outer margin of the bone. Fore and aft it is feebly concave.

The posterior sutural surface, fig. 5, exhibits the outlines of the upper and under surfaces.

The upper surface of the bone is not smooth, and is even rough and somewhat eroded on the outer division. It exhibits no distinct trace of grooves defining the position of scutes. The under surface of the bone is smooth, and exhibits near the inner border a fore and aft furrow, and near the middle a more feebly developed one, defining marginal scutes.

The length of the posterior sutural surface of the bone is a little over five inches; the thickness is three inches. The fore and aft extent of the upper surface is four and three-quarters inches.

The specimen I have referred to a species and genus with the name heading the present article.

TRIONYX.

I have repeatedly seen small fragments of the bony shell of species of *Trionyx*, from the Ashley deposits, but too small to determine from them any important specific character. Figure 3, Pl. xxxiv., represents a fragment of a costal plate, one-half the natural size, apparently an eocene fossil from Ashley River, presented to the Academy by Mr. C. S. Bement.

MYLIOBATES.

MYLIOBATES MAGISTER.

Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1876, 86.

A specimen of the dental armature of an eagle ray, in the Ashley collection of fossils, indicates one of the largest of its kind. It is one-fourth larger than the specimen from the same locality described and figured by Gibbes under the name of *M. Holmesii*. It is not improbable that it may have pertained to a larger individual of the same species, and its other differences may be accounted for by supposing that it belonged to the opposite surface of the mouth. The original specimen ascribed to *M. Holmesii*, judging from its convex triturating surface, belonged to the roof of the mouth. The specimen under consideration may be supposed to have belonged to the floor of the mouth. It is imperfect at the extremities and lateral borders. Represented in figure 7, Pl. xxxiii., the fore part is deeply worn in evidence of the service performed by the organ in comminuting hard food. The unworn surface is smooth, and is transversely convex, but slightly depressed along the middle. Fore and aft it is in a less degree convex.

The breadth of the median teeth is three and three-quarter inches, and five of these teeth unworn occupy an antero-posterior extent of two and a half inches. The sutural lines of the median teeth are slightly convex backward in the middle and more strongly convex forward at the sides.

The sutural lines of the median teeth are much less curved than is represented to be the case in the specimen ascribed to *M. Holmesii*, but perhaps this difference would exist between the upper and lower dental pavements of the species.

The under or attached surface of the plate is too much broken away to determine the greatest thickness of the pavement.

The specimen referred to *M. magister* is about as large as that of *M. Dixoni*,

Ag., from the eocene formation of Bracklesham, as represented in figure 14, Pl. xi., of Dixon's Geology of Sussex, England. The median teeth of the former are proportionately not so wide fore and aft as in the latter.

MYLIOBATES MORDAX.

Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1876, 86.

Several specimens of the dental armature of Rays from the Ashley phosphate beds, which have come under my observation, appear to indicate a species distinct from the former, and also from *M. Holmesii* as characterized by the specimen described by Dr. Gibbes.

Two of the specimens pertain to the collection submitted to my examination by Mr. J. M. Gliddon. One of them, represented in figure 1, Pl. xxxiii., is an inferior dental plate, and consists of the greater portion of nine median teeth together with part of the first row of small teeth on one side.

The triturating surface for the most part, nearly flat, is feebly curved fore and aft, but is more convex transversely, and becomes more so approaching the lateral borders. The surfaces of the median teeth successively incline slightly backward, so that their anterior margins are decidedly elevated above the contiguous margins of the teeth in advance. This arrangement produces an unusually uneven transversely ridged surface like that often observed on the surface of an ordinary rasp. The transverse sutures of the median teeth are nearly straight except at their extremities where they curve backward. Feeble ridges, not laterally symmetrical and interrupted by the prominent anterior margins of the median teeth, extend along the dental pavement.

The under surface of the dental plate slopes evenly from the median line to the lateral borders. At the middle, the dental plate, including the root, is ten lines thick. On the triturating surface, seven median teeth occupy an extent fore and aft of 28 lines. The first of this series measures in the same direction $3\frac{1}{2}$ lines; the last of the series, 4 lines. The breadth of the median teeth in their perfect condition has been about 38 lines.

From the dental plate of *Myliobates Holmesii*, from the same locality, as represented by Dr. Gibbes (Journ. Acad. Nat. Sc., 1850, Pl. xlii., fig. 1), the specimen just described differs in a number of points. While it has nearly the same breadth and thickness, thus indicating fishes of about the same size, the triturating surface is decidedly less convex transversely, the median teeth are proportionately of less width, and the transverse sutures are comparatively straight.

In addition, the triturating surface of the plate of *M. Holmesi*, if one can form a correct idea of it from the figure, appears even, as is usually the case, instead of being transversely ridged, from the successive inclination of the median plates, as in the specimen described.

The second of the two specimens, above referred to, is likewise a dental pavement from the floor of the mouth, and is represented in figure 2, Pl. xxxiii. It is composed of ten median teeth, and some of those of the first lateral row of small ones on both sides. The dental plate has about the same form as the preceding, but is of less breadth and much thinner, and, therefore, at least may be inferred to have belonged to a smaller individual. The triturating surface is feebly depressed along the middle, but has the same uneven character, though in a less degree, due to the slight elevation of the anterior borders of the median teeth, and the successive slight inclination of their surfaces. The transverse sutures are less straight than in the former specimen, especially the more posterior ones, which appear slightly bent forward, and also appear more open or wider.

On the triturating surface seven median teeth occupy an extent equal to the same number in the preceding specimen. The first and last of the series measure $4\frac{1}{4}$ lines. The breadth of the median teeth is about 30 lines. The thickness of the dental plate in the middle is $7\frac{1}{2}$ lines.

The inferior surface of the base of attachment slopes off from the median line with a slight inflection.

Another specimen, represented in figure 3, Pl. xxxiii., which may probably belong to the same species as the foregoing, is a superior dental plate, and was recently presented to the Academy by Mr. George S. Lewis. Its upper or attaching surface has adherent a quantity of calcareous rock, like that of the eocene marl rock, which underlies the Ashley phosphate beds. This serves to confirm the information derived from Prof. F. S. Holmes, that the specimen and others similar are eocene fossils.

The dental pavement consists of about a dozen median teeth together with part of the contiguous two rows of lateral teeth at the sides. The triturating surface is well arched fore and aft, and is also in a less degree convex transversely. The median teeth and intervening sutures are nearly straight transversely, but curve backward at the extreme ends. The conjoined edges of the median teeth are slightly prominent, giving the transversely ridged appearance more obvious in the preceding specimens of the floor of the mouth. Feeble ridges extend the length of the triturating surface.

The lateral teeth extend the convexity of the sides of the triturating surface.

The length of the specimen in its present condition is three inches five lines; its breadth three inches. Seven median teeth occupy an extent fore and aft of $25\frac{1}{2}$ lines, or $2\frac{1}{2}$ lines less than in the preceding specimens. The median teeth are 32 lines in breadth, and 4 lines fore and aft.

MYLIOBATES OBESUS.

Leidy: Proceedings Academy Natural Sciences, 1855, 396.

Myliobates rugosus, Leidy: Ibidem, 395.

In the neighboring State of New Jersey, in excavating the green sand marl, extensively employed as a fertilizer, many vertebrate fossils are found, mainly consisting of remains of reptiles and fishes. Three distinct marl beds are recognized alternating with beds of sand, clay, and limestone, all conformable with one another, and until recently all regarded as pertaining to the cretaceous period. Latterly, the lower two marl beds have been considered as of the cretaceous period, while the upper one has been viewed as belonging to the early tertiary or eocene period. Many fossils of the different marl beds have been presented to the Academy, and though having attached what is recorded as the name of the locality, this is usually that of the nearest town or village, while the particular bed from which they were obtained has been rarely designated. As a result we are frequently perplexed in attempting to ascertain the relative age of the fossils, which were once all ascribed to the cretaceous period, and which are now in part considered to belong to the eocene period.

Among the fossils of the marl beds presented to the Academy, there are many remains of fishes of which the teeth of sharks greatly predominate. The collection of the Academy contains a large and beautiful series of well-preserved teeth viewed as belonging to *Carcharodon angustidens** and *Otodus obliquus*. The greater number of these are from the neighborhood of Vincenttown, Burlington Co., N.J., presented by Col. T. M. Bryan. The two species were originally described by Agassiz, from teeth found in the tertiary deposits of Europe, and we may therefore suppose that the teeth from New Jersey ascribed to the same species were obtained from the upper or eocene marl bed.

Among the remains of fishes from the New Jersey marl beds there are also specimens of the dental armature of Eagle-rays, and as similar remains in Europe

* Gibbes (Journal A. N. S., 1847-50, p. 146) refers to some of the specimens as pertaining to another species with the name of *C. acutidens* founded on teeth from the eocene limestone of South Carolina. His views of these teeth (Pl. xxi., figs. 39-44), and such is also the case with the New Jersey teeth, are actually more like those of *C. angustidens*, as represented by Agassiz in the Poissons Fossiles, than those, likewise from the eocene of South Carolina, which Gibbes refers to the latter named species.

are alone ascribed to the tertiary formations, we may suppose that the New Jersey fossils belong to the upper or eocene marl bed.

A specimen formerly described under the name of *Myliobates rugosus*, represented in figure 10, Pl. xxxi., is from New Egypt, Ocean Co., and was presented to the Academy by T. A. Conrad. It consists of four unworn median teeth, the first and last with one extremity lost. The triturating surface is convex both fore and aft and transversely, and is wrinkled longitudinally to an unusual degree especially at the extremities of the teeth. The sutures of the median teeth curve backward, but are not deflected from this course at the ends.

The four teeth occupy an extent fore and aft of twenty lines. The first and second of the series measure $5\frac{1}{2}$ lines antero-posteriorly; the last one $4\frac{1}{4}$ lines. The second tooth is twenty-eight lines broad. The radical portions of the teeth are broken away, and the bases of the crowns are nearly straight transversely. The crown of the first tooth of the series is 5 lines thick at the middle, and it thins away to $1\frac{1}{4}$ lines at the ends.

A specimen represented in figures 8, 9, Pl. xxxi., from Vincenttown, presented to the Academy by Col. T. M. Bryan, consists of a pair of unworn median teeth. These sufficiently agree with the corresponding teeth of the preceding specimen to pertain to a smaller individual of the same species. They are highly polished on the free surface, and present scarcely any wrinkling except near the ends. The sutural borders transversely have almost the same extent of curvature as in the former specimen, and the triturating surface has nearly the same degree of convexity, but becomes rather more deflected at the ends so that the teeth are proportionately thicker in this position. The base of the crowns is straight, and the bottom of the root feebly slants from the middle laterally.

The two teeth measure fore and aft at the middle 8 lines, and in thickness $5\frac{1}{4}$ lines. The crown of the anterior tooth is 4 lines thick at the middle and 2 lines at the angular ends.

The specimen originally referred to *M. obesus*, figure 44, Pl. xxxiv., consists of two imperfect median teeth. It was found in the marl of Pemberton, Burlington Co., and was presented to the Academy by Dr. Charles H. Budd. The front tooth is worn, indicating the anterior position of the specimen in the dental series. The fore and aft extent of the two teeth is half an inch; the thickness is $4\frac{1}{4}$ lines.

An isolated median tooth from Mullica Hill, Gloucester Co., was presented to the Academy by Dr. Wm. B. Atkinson. It accords in form and size sufficiently well with the imperfect teeth of the specimen just indicated to belong to the same species, and to an individual of nearly the same size or age. The breadth of the

tooth is $18\frac{1}{2}$ lines; its thickness 4 lines. The width of the crown fore and aft is 3 lines; the thickness at the middle is $2\frac{1}{2}$ lines, and at the ends $1\frac{1}{2}$ lines.

Another isolated median tooth, represented in figures 6, 7, Pl. xxxi., is from the same locality and donor as the preceding specimen. With the exception of a slight unsymmetrical bend forward of one end, the tooth is straight, with the triturating surface transversely convex and even. The ends of the tooth are angular, and the bottom of the crown and the root are straight transversely. The breadth of the crown is 2 inches; its width fore and aft 5 lines; its thickness at the middle equals the width, and it diminishes to 3 lines at the ends. The tooth including the root is 7 lines thick at the middle.

The dental armature of *Myliobates obesus*, in the form and convexity of the median teeth, resembles that of *M. Dixoni*, Ag., from the eocene of Bracklesham, as represented in figures 1, 2, Tab. x., of Dixon's Geology of Sussex. The teeth in the latter appear generally to be of greater width fore and aft.

MYLIOBATES FASTIGIATUS.

Leidy: Proceedings Academy of Natural Sciences, Philadelphia, 1876, 86.

A specimen, represented in figure 6, Pl. xxxiii., of the dental armature of an eagle ray, differs from any which I have seen described, and may perhaps indicate a species different from any previously indicated. It is from Monmouth Co., N. J., probably from the "upper marl bed," or eocene green sand, and was presented to the Academy by William Cleborne.

From the arching form of the specimen it is to be viewed as having belonged to the roof of the mouth. It is composed of nine median teeth with the addition of some of the small teeth of the first row on each side. The fore part of the pavement extending to the third median tooth is much abraded from the attrition of food.

The pavement is well arched fore and aft, and in its present state measures three and one-third inches with a little less breadth. The triturating surface forms three longitudinal convex ridges, of which the intermediate one is the broader and more prominent. Broad shallow valleys separate the ridges, and the lateral ones of these include the small teeth.

The transverse median sutures curve backward on the median ridge and forward on the lateral ridges. The median teeth are three inches broad, and about five lines wide fore and aft. Their free surface is nearly even, but is feebly wrinkled in the valleys and upon the lateral ridges of the dental pavement.

The lateral hexagonal teeth are longer than broad, and each is impressed along the middle.

The upper surface of the dental pavement is concave fore and aft, and is convex or slopes off laterally from the median line. The thickness of the pavement on the median ridge is $9\frac{3}{4}$ lines; on the lateral ridges $5\frac{1}{2}$ lines.

Another specimen, represented in figure 11, Pl. xxxi., also from Monmouth Co., N. J., presented to the Academy by the late Dr. J. H. Slack, perhaps belongs to the same species as the preceding, though it exhibits some important differences. It is likewise an upper dental plate, and is worn away at the anterior part from the attrition of food. It retains seven median teeth, together with three small teeth of the first row of one side, and in its present condition measures two and a half inches long.

The pavement is considerably narrower in proportion with its length than in the former specimen, while the thickness in each is nearly the same. Seven median teeth in the first described plate measure together $31\frac{1}{2}$ lines by 35 lines in breadth; in the specimen under examination the same number of teeth measure $29\frac{1}{2}$ lines by 26 lines in breadth. The median convex ridge of the triturating surface is equally prominent, but the lateral elevations are nearly obsolete. The transverse sutures present but one flexure corresponding with the median one backward in the former specimen.

The median teeth range from $4\frac{1}{4}$ to $4\frac{3}{4}$ lines fore and aft. The thickness of the pavement on the median ridge is $8\frac{3}{4}$ lines; and at the sides $5\frac{1}{2}$ lines.

Prof. Marsh has noticed a specimen of a dental plate, in the Proceedings of the American Association for the Advancement of Science, 1869, from the eocene green sand of Monmouth Co., under the name of *Myliobates bisulcus*, to which one or other or perhaps both of the former may also belong. He remarks that it has "the central row of teeth marked along the median line by a deep groove. In other respects the dental surface is remarkably smooth and flat." These characters render it probable that it may be the inferior dental plate of the same species as that to which the former specimens pertain.

MYLIOBATES SERRATUS.

Leidy: Proceedings Academy Natural Sciences, 1855, 395.

This species was named on the specimen of a dental plate, represented in figure 5, Pl. xxxii., which was found in the marl of Pemberton, Burlington Co., N. J., and was presented to the Academy by Dr. Charles H. Budd. It resembles most the dental armature of *Myliobates toliapicus*, Ag., and *M. suturalis*, Ag.

The specimen consists of the greater part of six median teeth, and four of the first row of teeth on each side. The triturating surface of the plate is dull in aspect, flat, but slightly impressed along the median line, and inclines forward and inward on the first tooth, apparently as the result of wearing.

The transverse sutures of the median teeth are gently curved with the convexity backward. The lateral teeth are hexagonal, and nearly as broad as they are fore and aft wide.

The sutures generally, but especially the outer parts of the median transverse sutures and those uniting the median and lateral teeth, as well as these together, are remarkable for their unusually serrulate condition. The same character is remarked in *Myliobates suturalis*. The root surface of the specimen slopes strongly on each side from the median line. The width of the plate fore and aft of six teeth measures 10 lines; the breadth including the first lateral row of teeth is $12\frac{1}{4}$ lines. The breadth of the median teeth is 10 lines; the fore and aft extent of the fourth median tooth is 2 lines.

MYLIOBATES JUGOSUS.

Leidy: Proceedings Academy Natural Sciences, Philadelphia, 1876, 86.

An isolated median tooth, represented in figures 4, 5, Pl. xxxi., probably indicates a species of eagle ray different from the former. The specimen is likewise from the marl of Vincenttown, Burlington Co., N. J., and was recently presented to the Academy by Col. T. M. Bryan.

The tooth is transversely nearly straight, and the ends are angular and adapted to the articulation of small hexagonal teeth as in the species of *Myliobates* generally. The crown forms a thick median transversely convex prominence with the sides extended outwardly and thin. The prominence appears as an exaggeration of the median ridge of the dental plate of *M. fastigiatus* due to the more abrupt depression of the sides of the crown. The tooth at the median prominence is no thicker than in the smaller of the dental plates described under the name of *M. fastigiatus*, while it is considerably broader. The triturating surface is transversely convex on the median prominence and becomes nearly flat upon its reflected sides. The dull aspect of the triturating surface, and the comparatively thin condition of the sides of the crown probably indicate some reduction as the result of wearing. The anterior inclining surface of the crown and the projecting posterior surface indicate a somewhat imbricated arrangement of the median teeth. In the specimen the back of the eminence of the crown is unsymmetrical, apparently deformed. The base of the crown opposite the median eminence is concave, and this curvature at the sides is slightly deflected. The root is straight on its attaching surface.

The breadth of the tooth is nearly $2\frac{1}{2}$ inches; its median height $8\frac{3}{4}$ lines, and at the sides 4 lines. The width of the crown fore and aft is about 5 lines, and its thickness at the middle about the same, while at the sides it is but $1\frac{1}{2}$ lines.

MYLIOBATES GIGAS.

Cope: Proceedings Academy Natural Sciences, 1867, 140.

This species was first described and named by Prof. Cope from remains found in the miocene formation of Charles Co., Maryland. Of the specimens, presented to the Academy, the best is represented in figure 4, Plate xxxiii. It consists of a dental pavement, indicating by its strongly arched condition antero-posteriorly that it pertained to the roof of the mouth. It retains portions of thirteen median teeth, together with part of two rows of lateral teeth on one side, and of one row on the other side. In its present state it measures four inches in its extreme length. The fore part of the pavement including six median teeth is more than half broken away, while the remaining portion of the same teeth is much abraded from the attrition of food. The pavement is comparatively thin in proportion with its breadth. The triturating surface is convex transversely, and is more curved at the sides than across the middle. It is nearly even and smooth, and exhibits but feeble striation fore and aft. The median teeth and their intervening sutures are straight along the middle, but curve backward at the extremities. The posterior median teeth are wider fore and aft than the more anterior ones.

Two lateral rows of teeth appear to have completed the dental pavement at the sides. In the specimen the teeth of the inner lateral row are not symmetrical on the two sides, three on the right being longer than broad, while three of the left are nearly equal in the same directions. Their front and back sutures are the shortest, and slant outward and backward; the antero-internal and postero-external sutures are intermediate in length to the former and those opposite to them. The teeth of the outer row are convex along the external border, but more abruptly rounded posteriorly.

The upper or attached surface of the dental plate is feebly elevated at the lateral borders and middle.

The posterior seven median teeth, except the last one, occupy an extent of two and a half inches. The breadth of the median teeth is 3 in. $2\frac{1}{2}$ lines. The width fore and aft of the seventh median tooth is 4 lines; of the twelfth tooth, 5 lines. The thickness of the dental plate at the middle is $6\frac{1}{2}$ lines.

A fragment of a second specimen presents nearly identical characters, but is less even on the triturating surface due to the slight prominence of the anterior

portions and depression of the contiguous posterior portions of the median teeth as in *Myliobates mordax*.

MYLIOBATES VICOMICANUS.

Cope: Proceedings Academy Natural Sciences, 1867, 140.

The species thus named by Prof. Cope was based on specimens found in association with those attributed to *M. gigas*. The best preserved of the specimens represented in figure 5, Plate xxxiii., consists of an inferior dental pavement. It retains eleven median teeth, together with part of two lateral rows on one side, and of one row on the other side, and measures a little over three inches in length. The anterior three or four median teeth are abraded from the trituration of food.

The plate beneath is almost straight fore and aft, and is slightly convex in the same direction on the triturating surface. This is also moderately convex transversely, but is feebly depressed along the middle. The surface is comparatively even and smooth.

The median teeth and intervening sutures are nearly straight across the middle of the pavement, but present a feeble convexity backward, while the ends curve backward.

The lateral teeth have the same character as in the former specimen ascribed to *M. gigas*, and as in this, there appear to have been but two rows on each side.

Seven median teeth except the last in the specimen, measure together fore and aft $25\frac{1}{2}$ lines. The fifth tooth is $3\frac{3}{4}$ lines wide fore and aft, and the eighth one is 4 lines wide. The breadth of the median teeth is $27\frac{1}{2}$ lines.

The under surface of the dental plate slopes off on each side from the median line, where the plate is half an inch thick.

M. gigas has been characterized alone from the superior dental armature, and *M. vicomicanus* alone from the inferior dental armature. The characters of the two armatures are sufficiently alike to render it probable that they may pertain to the same species.

MYLIOBATES PACHYODON.

Cope: Proceedings Academy Natural Sciences, 1867, 140.

A third species of an eagle-ray was described by Prof. Cope, under the above name, from a fragment of a dental plate, represented in figure 6, Plate xxxii., which was found in association with the former in Charles Co., Md. The specimen retains portions of four median teeth together with portions of several of a lateral row, and in its present condition measures $1\frac{3}{4}$ inches long. It appears to

be a fragment of the inferior dental pavement, and at its fore part is worn from the attrition of food. It is especially remarkable for its thickness in relation with its breadth; the crowns of the teeth at the middle of the plate being $7\frac{3}{4}$ lines thick, and thin away to a sharp edge at the lateral border, in a distance of an inch and a quarter.

The triturating surface is transversely convex and even. The median teeth with their intermediate sutures are nearly straight, and curve backward but slightly at their outer extremities.

Apparent traces of a second row of small teeth are seen in the specimen external to the more conspicuous teeth of the first row.

The intermediate two median teeth of the specimen measure each fore and aft 5 lines. The breadth of the median teeth in a complete condition appears to have been about $2\frac{1}{2}$ inches. The thickness of the dental plate in the middle is 10 lines. The inferior surface slopes with a slight inflection from the middle to the lateral border.

In the proportionate thickness and breadth of the dental plate and the convexity of the triturating surface, it resembles that of *Myliobates Holmesii*, but the median teeth and transverse sutures differ in their comparative straight course.

MYLIOBATES.

Several fragments of dental plates, found with the preceding in Charles Co., Md., may perhaps pertain to another species. One of the specimens, represented in figure 7, Pl. xxxii., consists of a portion from the back part of an inferior dental pavement, comprising five median teeth with portions of one contiguous lateral row. The triturating surface is nearly flat, being slightly convex transversely fore and aft. The median teeth and their intervening sutures are more straight than in any of the specimens previously described, except that referred to *M. serratus*. The transverse sutures, though generally nearly straight, are slightly irregular in their course. In the specimen the first one bends a little forward towards the middle; the second is the straightest of the series; the third and fourth are nearly like the first.

The inferior surface of the dental pavement slopes gently from the median line towards the lateral borders.

Thickness of the pavement at the middle 5 lines; probable breadth when entire about $2\frac{1}{2}$ inches. Breadth of median teeth when entire about 28 lines; fore and aft width of the same ranging from 4 to 5 lines.

Another specimen is a fragment from the anterior worn part of a dental pavement, comprising portions of four median teeth with the contiguous two rows of smaller ones of one side. The triturating surface is worn concavely forward, and is convex on the position of the small teeth. The median teeth and intervening transverse sutures are as straight as in the former specimen, but the teeth are not so wide fore and aft. The lateral teeth of the specimen apparently indicate two rows to render the sides of the plate complete.

MESOBATIS EXIMIUS.

Ætobatis eximius, Leidy: Proceedings Academy Natural Sciences, 1855, 396.

This species was originally indicated from the specimen represented in figure 12, Plate xxxi. It was obtained by the late Capt. A. H. Bowman, from the sands of Ashley River, S. C., and is supposed to have been derived from the eocene formation. The specimen consists of little more than half of four median teeth with the lateral teeth. The triturating surface is nearly flat, but rounded at the border, and is feebly wrinkled longitudinally. The transverse sutures the greater part of their course are nearly straight, but curve backward approaching the ends, and they exhibit the slightest posterior inflection at the middle.

The lateral teeth formed but a single row, occupying the angular notches between the ends of the median teeth. Their outer border is fore and aft convex. The bottom of the roots forms a flat surface slightly sloping from the median line. The estimated breadth of the dental pavement is scarcely two inches; the fore and aft extent of the four median teeth is thirteen lines. The breadth of the median teeth is 22 lines; the fore and aft width, $3\frac{1}{3}$ lines; the thickness at the middle, 4 lines. The crowns are $2\frac{3}{4}$ lines thick at the middle and thin outwardly to nothing at the angular ends. The lateral teeth are 3 lines long and $1\frac{1}{4}$ lines broad.

ÆTOBATIS PERSPICUUS.

Leidy: Proceedings Academy Natural Sciences, 1855, 396.

This species was first indicated in 1855, by the fragment of a tooth represented in figure 13, Plate xxxi. The specimen was found in Monmouth Co., New Jersey, and was presented to the Academy by Dr. J. L. Burtt. No other specimen which can be attributed to the same species has been brought to my notice. Though considered to belong to the upper dental pavement, I am not satisfied that such is its correct position. Taking, however, this view of it, the transverse borders extend relatively further forward than in the recent *Ætobatis narinari*.

The triturating surface is flat, and the end only slightly rounded. The enamel-

loid layer turns abruptly upward at the end of the tooth for about one line. The anterior border of the tooth is angularly convex the greater part of its extent, but is feebly deflected in the opposite direction laterally. At the end it presents a projection adapted to a crescentoid depression or socket of the contiguous tooth. The posterior border, corresponding in its course with the anterior, presents a narrow flange along the greater part of its length, and a crescentoid socket at the end of the tooth, adapted to receive the projecting border of the contiguous tooth. The thickness of the tooth at the middle is four lines, from which it thins off to $2\frac{1}{2}$ lines just within the rounded lateral border. The breadth of the tooth has been about $2\frac{1}{4}$ inches; the width fore and aft is four lines

The tooth is nearly like the corresponding ones of *Ætobatis irregularis*, Ag., from the eocene of Bracklesham, as represented in figure 7, tab. x., and figures 2-4, tab. xi. of Dixon's Geology of Sussex, England. It bears much less likeness to those of the specimen ascribed to the same species and represented in figure 3, tab. 47 of the Poissons Fossiles.

ÆTOBATIS ARCUATUS.

Agassiz: Poissons Fossiles. Gervais: Paléontologie Française, Pl. 80, 1-3. Cope: Proceedings Academy Natural Sciences, 1867, 139.

Numerous isolated teeth from the miocene formation of Charles River, Maryland, have been referred by Professor Cope to the above-named species, originally described by Agassiz from specimens found in the miocene formation of Switzerland.

The teeth, generally worn and in fragments, sometimes vary so much as to render it uncertain whether to consider them as belonging to the upper or lower series. They resemble in form those of the living *Ætobatis narinari*, but, unless the difference is due to wearing, they appear to have proportionately thinner crowns and longer roots.

Figure 14, Plate xxxi., represents the left half of an inferior tooth. Its triturating surface is flat and slightly wider at the ends than at the middle. The front and back borders are nearly parallel but slightly inflected, and are oblique at an angle of about 45° . The outer end is rounded off rather more abruptly than in *A. narinari*. The breadth of the fragment obliquely is $1\frac{1}{2}$ inches; the width ranges from $2\frac{3}{4}$ to $3\frac{1}{2}$ lines. The length of the root internally is half an inch.

Figure 15 represents the median portion of an inferior tooth. The triturating surface is wider than in the preceding specimen, and the angle formed by the conjunction of the two sides is more prominent forward than it would appear to have

been in the other tooth. The width of the crown fore and aft at the middle is $4\frac{1}{2}$ lines; the length of the root is half an inch.

Figure 16 represents an inferior tooth with the extremity of the left side lost. The median portion is unsymmetrical, on the right appearing to be more abruptly produced forward than on the left. The side of the tooth narrows rapidly from the median line outwardly. The breadth of one side of the crown is about $1\frac{1}{2}$ inches; the width at the middle is $4\frac{1}{2}$ lines, and at the outer end $2\frac{1}{4}$ lines. The length of the root is half an inch. The breadth of the dental plate, estimated from this specimen, would be about two inches and a third.

Figure 17 represents the right portion of a superior tooth. The triturating surface is flat at the middle, but slightly convex laterally. The front and back borders are less oblique than in the lower teeth, forming an angle of nearly 10° less. At the middle the same borders are less angularly curved; and the front border at its outer end is more deflected forward. The breadth of one side of the crown is about 16 lines; the width of the triturating surface at the middle is $3\frac{3}{4}$ lines; near the outer end where narrowest, $2\frac{1}{2}$ lines. The length of the root is about five lines.

Figure 18 represents a fragment from the left side apparently of an upper tooth. The triturating surface has a greater width than in the preceding specimen, especially towards the middle. The lateral borders appear more oblique and more abruptly deflected inwardly to the middle than in the former. Width of the triturating surface fore and aft at the middle, $5\frac{1}{2}$ lines; at the side, $2\frac{3}{4}$ lines. Length of the root, 9 lines.

Perhaps this specimen may pertain to a different species from the preceding.

ÆTOBATIS PROFUNDUS.

Cope: Proceedings Academy Natural Sciences, 1867, 139.

Isolated specimens of teeth, mingled with those above described, Professor Cope has referred to a distinct species with the name of *A. profundus*. They appear to me to be only the most anterior and worn teeth of the same species as those referred to *A. arcuatus*, as similar differences are observed between the corresponding teeth of the recent *A. narinari*.

Figure 19, Plate xxxi., represents an anterior tooth of the lower dental series. The two sides of the crown meet at an obtuse rounded angle forward, and the triturating surface is worn off in a convex manner anteriorly. The ends of the crown also appear to be worn off. The breadth of the crown is 17 lines; the width fore and aft at the middle is $2\frac{1}{2}$ lines. The length of the root is about five lines.

Figure 20 represents the left portion of a similar tooth of a larger individual, presenting the same characters as the preceding specimen. The breadth of the right side of the crown is 17 lines; its width at middle, $2\frac{3}{4}$ lines. The length of the root is 5 lines. The breadth of the dental plate estimated from this tooth fragment, is about two inches.

ZYGOBATES DUBIUS.

Leidy: Proceedings Academy Natural Sciences, 1855, 396.

A species of eagle ray, with the dental organs tessellated in the manner of the recent *Zygobates Jussieu*, was formerly indicated under the above name from a number of isolated teeth, obtained from the Ashley River deposits by Capt. A. H. Bowman. Similar isolated teeth are occasionally noticed among the collections of fossils from the more recent explorations of the phosphate beds of the same locality.

Figures 21–37, Plate xxxi., represent teeth of the kind to which we allude.

A median unworn tooth, represented in figures 21, 22, in form and size is nearly like the more posterior unworn median teeth of the living *Zygobates Jussieu*. It is straight transversely, but slightly bent, so that the triturating surface is a little concave from side to side. The triturating surface is feebly convex fore and aft, highly polished, and slightly wrinkled longitudinally. The breadth of the crown between the rectangular ends is an inch and a half; the width fore and aft one fourth of an inch, and the thickness both at the middle and sides is three and a quarter lines. The root of the tooth is lost.

A second specimen of a median unworn tooth, represented in figure 23, resembles the preceding, but is not bent in the same manner. Its measurements are as follow: breadth, $13\frac{1}{2}$ lines; width, $2\frac{3}{4}$ lines; thickness, $4\frac{1}{2}$ lines; thickness of crown, $3\frac{3}{4}$ lines.

A third specimen represented in figures 24, 25, is different enough in character to pertain to another species. In its greater proportionate width fore and aft, in the dull aspect and evenness of its triturating surface, and in the comparative thinness of its crown, it resembles the more anterior worn teeth of the existing *Zygobates Jussieu* in relation with the posterior unworn teeth. It is well arched with the triturating surface convex transversely, instead of being nearly flat or slightly concave as in the former specimens. Its measurements are as follow: breadth, 16 lines; fore and aft width, 4 lines; thickness, 3 lines; thickness of the crown, 2 lines.

A fourth specimen, represented in figures 26, 27, is like the last, but is of much less width fore and aft. Its measurements are as follow: breadth, 16 lines; fore

and aft width, 3 lines; thickness, $3\frac{1}{4}$ lines; thickness of crown, $2\frac{1}{4}$ lines. The differences from the former are such as are observed in intermediate teeth to the worn and unworn teeth of the recent *Zygobates Jussieu*.

Figures 28–33 represent three teeth, which from the difference in thickness between their outer and inner ends, indicate a position in the series succeeding the median one. The dull aspect of the triturating surface and the comparative thinness of the crown show that they are all worn specimens. Their measurements are as follow:—

Breadth of crown	.	.	.	$12\frac{1}{2}$ lines.	11 lines.	$10\frac{1}{2}$ lines.
Width fore and aft	.	.	.	$4\frac{1}{4}$ "	4 "	$2\frac{1}{2}$ "
Thickness internally	.	.	.	2 "	$1\frac{3}{4}$ "	$1\frac{1}{4}$ "
" externally	.	.	.	$1\frac{1}{4}$ "	1 "	$\frac{3}{4}$ "

A small tooth, represented in figures 34, 35, resembles those of the third row outwardly from the median series of the recent *Z. Jussieu*, except that it is broader than usual in proportion to its fore and aft width. It is hexagonal, broader than wide, and thicker internally than externally. Its dimensions are as follow: breadth, $5\frac{1}{4}$ lines; width, 3 lines; thickness of the crown internally, $2\frac{3}{4}$ lines; externally, 2 lines. The root is broken away.

Another small tooth, represented in figures 36, 37, is unlike any with which I am familiar, and perhaps pertains to a different species from the preceding. It is from the outermost row of the dental series, and is about four times as broad as wide fore and aft. The inner end is rectangular and thick, and the tooth thins away outwardly to a sharp border. The outer end is rather abruptly curved backward. The measurements are as follow: breadth, 8 lines; width, 2 lines; thickness of the crown internally, $2\frac{1}{4}$ lines. The root is broken away.

Prof. Emmons, in his Report of the North Carolina Geological Survey for 1858, page 243, has represented several isolated median teeth, under the name of *Trygon carolinensis*, from the eocene marl of Craven Co., North Carolina. They resemble specimens from Ashley River attributed to *Zygobates dubius*, and perhaps pertain to the same.

CERATOPTERA.

CERATOPTERA UNIOS.

Leidy: Proceedings Academy of Natural Sciences of Philadelphia, 1876, 86.

Among the fossils of the Ashley phosphate beds, an interesting one recently obtained is the specimen represented in figures 1, 2, Plate xxxiv. It appears to

be the bone, corresponding with that existing in the living Devil-fish, *Ceratoptera vampirus*, at the root of the tail and supporting a minute spine, the rudiment of the formidable barbed spines of the Sting-rays. Compared with the bone of the living Devil-fish of our southern coast, as represented in figures 2, 3, Plate 3, of Prof. Holmes' description of the American Devil-fish, published in the Proceedings of the Elliott Society for 1856, the fossil presents sufficient differences to render it probable that it belongs to a distinct species. The fossil is about as long, but nearly double the breadth and height of the bone in the recent fish, and also presents other important differences.

The fossil knob forms a cone with striated sides sloping from an elongated ridge. The base is nearly flat and rugged, and has an irregular ovoid outline with the narrower end directed posteriorly.

The ridge of the summit is most prominent and obtuse in front, and it becomes more acute and gradually slopes off posteriorly. A narrow somewhat interrupted groove extends along its intermediate part. In front and at the sides narrow ridges separated by furrows descend from the summit of the knob in a radiant manner to the irregularly scalloped border of the base. The front slope is somewhat defined from those of the sides by greater prominence of the surface. Posteriorly a strong escarpment rises from the base of the bone into a thick, obtuse, transverse ridge, nearly on a level with the posterior end of the summit of the knob. The transverse ridge having offsets converging from the ends to the sides of the knob, incloses a transverse groove. The position of attachment of a rudimental spine, if such existed, is not obvious.

The length of the base of the fossil is $3\frac{1}{4}$ inches, the breadth 2 inches; the height of the summit at its fore part from a level, $1\frac{1}{2}$ inches.

Supposing the fossil to indicate an extinct and previously unknown species, I have proposed for it the name heading this article.

GRYPHODOBATIS.*

GRYPHODOBATIS UNCUS.

Figures 8 and 9 of Plate xxxiv. represent a tooth, twice the natural size, from the Ashley phosphate beds, which may be the symphysial tooth of a Shark, or perhaps the tooth of a Ray. The crown is a narrow curved cone with a laterally expanded base, and twice the length on its external face that it is on the inner face. The point curves inward and posteriorly. The outline of the base in front

* Contracted from *Gryphodontobatis*.

is convex. The outer lateral border presents a single denticle a short distance from the summit. The root extends below the crown with a prominent obtuse convex border, and projects backward in a broad trilobate base, as seen in figure 9.

Length of the tooth in front, $4\frac{3}{4}$ lines; breadth, $3\frac{1}{2}$ lines. Length of the crown in front, $3\frac{1}{2}$ lines. Height of base of root posteriorly, $3\frac{3}{4}$ lines; breadth, $3\frac{1}{4}$ lines.

ACRODOBATIS.*

ACRODOBATIS SERRA.

Among the fish teeth occurring in collections of fossils from the Ashley phosphate beds, I have noticed a number which appear to pertain to a species of Ray. Teeth of the kind are represented in figures 10–13, Plate xxxiv., twice the natural size. They may perhaps be symphysial teeth of a Shark.

The crown of these teeth is usually wider than high, and the base is extended downward at the middle in a rounded prominence, and backward posteriorly in a similar prominence. The summit rises in a tapering point, and the lateral acute borders exhibit seven or eight denticles successively decreasing towards the base. The teeth of figures 10, 11, have the main point worn off and the lateral denticles more or less abraded. The tooth of figure 12 has the main point partially worn off; and even that of fig. 13 has the extreme point somewhat blunted by abrasion.

The root of these teeth is a shallow basis with a trilateral outline, the angles rounded and the lateral ones slightly projecting.

ACRODOBATIS OBLIQUUS.

Figure 14, Plate xxxiv., represents a tooth nearly like those just described, but having the main point directed to one side so as to recall to mind the teeth of *Galeocerdo*. The specimen was obtained in the marl of Monmouth Co., New Jersey, and was presented to the Academy by Dr. Knieskern. The inner acute border of the crown is the longer, and is convex in its course from the base of the main point. It presents seven denticles successively decreasing in size. The outer side presents two larger denticles succeeded by four minute ones. The construction of the base of the crown is like that of the preceding teeth.

Length of the tooth, 3 lines; breadth, $3\frac{1}{4}$ lines; thickness at base, $2\frac{3}{4}$ lines.

I have regarded the tooth as representing a species distinct from that to which the Ashley fossils pertain, under the name above given.

* Contracted from *Acrodontobatis*.

XENODOLAMIA.*

XENODOLAMIA PRAVUS.

Shark teeth of an unusual form, from the Ashley phosphate beds, are represented in figures 33–36, Plate xxxiv. I have supposed that these may be symphyseal teeth of *Carcharodon megalodon*, or perhaps of *C. angustidens*, but I have not been able to determine the question. Nor is it positive that all these teeth pertain to the same species or genus.

In all the specimens the root exceeds the crown in bulk, and in comparison with the usual condition of the root in the teeth of Sharks has the appearance of being deformed.

In the largest tooth, figure 33, the crown is demi-conical, somewhat tapering and nearly straight, and its lateral acute borders are denticulate. The length and breadth of the root are nearly equal, and both are much greater than the length of the crown. It forms a prominence at the base of the crown to one side of the middle nearly as thick as the length of the crown on its inner face. The processes of the crown form two cones projecting in the same direction obliquely. Length of the tooth from the bottom of the root notch, 10 lines; length of crown medially and posteriorly, $5\frac{1}{2}$ lines; breadth at base, 8 lines; greatest length of root, 8 lines; breadth, $8\frac{3}{4}$ lines; thickness, $4\frac{1}{2}$ lines.

The tooth represented in figure 34 is about half the size of the preceding. The crown is oblique and more expanded laterally at the base, and the borders are more distinctly denticulated. The inner process of the root is proportionately less prominent and the outer one is undeveloped.

Length of the tooth from the point to the notch of the root, $5\frac{1}{2}$ lines; length of crown on the posterior face, 3 lines; breadth at base, $5\frac{3}{4}$ lines.

XENODOLAMIA SIMPLEX.

The remaining pair of teeth perhaps belong to a different species and genus. The crown is very much smaller in proportion to the root than in the former, and its lateral borders are not denticulated.

The tooth represented in figure 35 has a small oblique, demiconoidal crown with a rather wide and slightly recurved summit. The root is of comparatively enormous proportion, and resembles in shape that of the large tooth first described.

Length of the tooth from the root notch, 5 lines; length of crown, $1\frac{1}{2}$ lines; breadth at base, $2\frac{3}{4}$ lines; length of root, $6\frac{3}{4}$ lines; breadth, 7 lines.

* Contracted from *Xenodontolamia*.

The tooth of figure 36 has the crown proportionately larger and the root thicker but narrower, and with but feebly developed processes.

Length of the tooth, 6 lines; length of the crown, 2 lines; breadth at base, $3\frac{1}{2}$ lines; length of crown at middle, $4\frac{1}{2}$ lines; breadth, 4 lines; thickness, 3 lines.

XIPHODOLAMIA.*

XIPHODOLAMIA ENSIS.

While engaged in describing some unusual forms of the teeth of Sharks, I take the opportunity of noticing another from the marls of New Jersey. The teeth to which I refer are probably symphysial, but their relationship with lateral associates remains undetermined. The museum of the Academy contains twelve of these teeth, of which six are from Vincenttown, presented by Col. T. M. Bryan; four from Monmouth Co., presented by Dr. P. Knieskern; one from Burlington Co., presented by Dr. C. C. Abbott; and one from Allowaystown, presented by Dr. H. C. Yarrow. The teeth have the general appearance of those of *Lamna* laterally compressed.

The crown of the tooth usually, as represented in figures 25–28, Plate xxxiv., has a sigmoid sabre-like form with the anterior border sharp and the posterior border obtuse. The root has the construction of that of a *Lamna* tooth, but the two sides appear pressed towards each other, so that the processes are directed obliquely and parallel. In some teeth, as in figure 27, the processes are nearly or quite equal; in other teeth, as in figures 25, 26, one process is shorter than the other.

Figures 29 and 30 represent transitional forms from that above indicated to the more ordinary one of *Lamna* teeth. In one of these, fig. 29, the crown is sharp a short distance below the point on the outer border, as it is the entire length along the inner border; in that of fig. 30 the crown is sharp along both borders. The root in both teeth is not laterally compressed, but has nearly the common form seen in most teeth of Sharks.

PRISTIS.

PRISTIS ENSIDENS.

Leidy: Proceedings Academy of Natural Sciences, Philadelphia, 1855, 414.

Multitudes of isolated teeth of several species of Saw-fish have been found in the Ashley phosphate beds. From among a number of specimens in the museum

* Contracted from Xiphodontolamia.

of the Academy, a long time ago described by me under the above name, two are selected and represented in figures 31, 32, Plate xxxiv. The teeth are straight, and have both borders alike and subacute.

The larger tooth is an inch and a half long and half an inch broad; the smaller tooth is 11 lines long and 5 lines broad.

CARCHARODON MEGALODON.

Multitudes of teeth referable to this species are obtained from the phosphate beds of South Carolina. Among them are some which exceed in size those which have been reported from other localities. The following notes of measurements were taken from some of the largest specimens observed:—

1. A tooth, contained in a show-case of the Bradley Fertilizer Co. in the Agricultural Hall of the International Exhibition, from the phosphate beds of the Company on the Stono River, measures 6 inches 8 lines in length from the level of the ends of the fangs to the end of the tooth, and is 4 inches 8 lines in width across the base.

2. A second specimen, in the same collection from the same locality, is 6 inches in length, and 5 inches 1 line in breadth.

3. A specimen, from the Ashley River, formerly in the possession of Professor Holmes, measures 6 inches 5 lines long, 5 inches 5 lines broad, and weighs 2 lbs. 3 drs., apothecaries' weight.

4. A second specimen, from the same locality, has the same length, and is 4 inches 10 lines in breadth.

5. Two additional specimens, from Ashley River, measure 5 inches 10 and 11 lines in length, and 4 inches 6 and 7 lines in breadth.

6. A specimen, from a railroad cutting 27 miles from Charleston, purporting to be derived from the eocene marl, is 5 inches 8 lines long, and 4 inches 5 lines broad.

Besides the foregoing, among the multitude of teeth of Sharks, observed in the various collections of fossils from the South Carolina phosphate beds at the International Exhibition, I noted particularly those of the following species:—

CARCHARODON ANGUSTIDENS. Abundant.

In the collection of the Bradley Fertilizer Co., in Agricultural Hall, there is a specimen of a large tooth of this species, imbedded in a hard phosphatic nodule about the size of two fists. The projecting crown is about $2\frac{3}{4}$ inches in length, with the base about 2 inches in width. The specimen was derived from the Bulow tract between Ashley and Stono Rivers.

The collection contains many other teeth of the same species, together with teeth of *Carcharodon megalodon* and other Sharks, and a well-preserved dental pavement of *Myliobates mordax*.

With these there were also vertebræ of Sharks; among them one of a *Carcharodon* $3\frac{6}{10}$ inches broad and $1\frac{1}{10}$ inches long; another measured $3\frac{1}{5}$ inches broad and $1\frac{2}{5}$ inches long.

The collection further contains vertebræ, teeth and ear bones of Cetaceans, and teeth of Elephant, Mastodon, Horse, and a Deer, all obtained from the Bulow tract.

CARCHARODON LANCIFORMIS. Moderately frequent.

NOTIDANUS PRIMIGENIUS. Seldom.

HEMIPRISTIS SERRA. Abundant.

GALEOCERDO ADUNCUS. Moderately frequent.

GALEOCERDO CONTORTUS. Abundant.

PRIONODON ANTIQUUS, Agassiz.

Galeocerdo minor, Gibbes. Abundant.

LAMNA ELEGANS. Frequent.

OXYRHINA HASTALIS. Moderately abundant.

OXYRHINA XIPHODON. Moderately abundant.

SPHYRÆNA MAJOR.

Leidy: Proceedings Academy Natural Sciences, 1855, 397.

Isolated teeth of a large species of *Sphyræna* are frequent among the fossils of the Ashley phosphate beds. The first specimens brought to my notice were obtained by the late Capt. Bowman from the sands of Ashley River. All that I have examined, perhaps amounting to several hundred, have been shed teeth, or such as had not had the root developed.

Figures 37, 38, Plate xxxiv., represent teeth of the ordinary form. These appear to be somewhat broader in proportion to their length than in the great Barracuda Pike. They are flattened conical, with trenchant borders and sharp point. The borders and point are defined from the body of the tooth by a delicate line, and the edges when unworn are minutely crenulate. The lustrous enamel-like dentinal investment of the teeth is regularly and minutely striate in the length; in some specimens the striæ becoming more distinct towards the base.

Figure 39 represents a tooth of similar form to those just described, but presenting a coarsely striated appearance towards the base.

Figures 40, 41, represent teeth like those arming the anterior extremity of the mandibles and intermaxillaries in the Barracuda Pike. These are compressed

conical, with the anterior border trenchant and the posterior border obtuse. They are slightly bent backward from near the base, and have a slight posterior barb-like projection to the point. The largest specimen is more coarsely striate at the base than in the smaller ones, and it also exhibits an excavation produced by the encroachment of its successor.

DIODON VETUS.

Leidy: Proceedings Academy Natural Sciences, 1855, 397.

Diodon antiquus, Leidy, Cope: Kerr's Report Geol. Survey of North Carolina, 1875, Appendix 31, Plate viii., fig. 6.

Among the fossils of the Ashley phosphate beds there not unfrequently occur specimens of the dental armature of a species of *Diodon*. The first specimens brought to my notice were obtained by the late Capt. A. H. Bowman, U. S. A., in sand dredged from the Ashley River, and were described in the Proceedings of this Academy for 1855. As usual with the Ashley fossils, the remains of the *Diodon* consist only of the hardest part of the skeletal structure—the dental armature devoid of the osseous jaws.

In the existing Striped Balloon-fish (*Diodon maculo-striatus*, *Chilomycterus geometricus*), the exposed margins of the jaws are occupied with a dental armature forming a crescentoid band composed of a multitude of small flattened denticles co-ossified with one another and with the jaw. Within the position of the marginal dental armature there is a second, appearing as a large tubercle, composed of broad laminar denticles arranged in two piles. These piles are co-ossified in the median line and with the marginal dental armature in front, as well as with the jaw itself, the whole together forming a solid mass.

The fossils consist of the marginal and the internal or oral dental armatures retained in conjunction, or separated, and frequently of the elements of the same more or less isolated. The decomposing effect of the water to which the remains were subjected, has rendered the structural elements of the dental armature more distinct than in recent specimens. From among a number of the fossils two of the most complete are represented in figures 15, 16, Plate xxxiv., and they consist of the marginal dental armature still retained in conjunction with the interior or oral dental armature.

In one of the specimens, figure 15*a*, the oral dental tubercle is worn concavely with the hollow directed backward; in the other, figure 16, it is worn convexly, indicating that this was opposed to the former. A similar difference between the oral dental tubercles of the upper and lower jaw is scarcely obvious in several specimens of our common Striped Balloon-fish which I have examined.

The marginal dental armature is composed of a number of horizontal rows of small curved quadrate plates associated by intervening ossific substance. The anterior face of the armature resembles that of a wall built of tiles imbedded in mortar.

The oral dental armature is made up on each side of about ten plates united by cementum. The unworn plates, as seen on the surface of the piles opposite the triturating surface, are variable in outline in different specimens, as represented in figures 15*b* and 18. The differences might be suspected to be specific, but in eight specimens no two are alike.

The age of the fossils, like many others of the Ashley phosphate beds, is uncertain. They are supposed to be derived from the so-called eocene marl rock.

Professor Cope has indicated specimens from the miocene of North Carolina (Kerr's Report of the Geol. Surv. of N. C., 1875, Appendix, p. 31, Pl. viii., fig. 6), which he attributes to the same species, but inadvertently ascribes them to me under the name of *Diodon antiquus*.

PHARYNGODOPILUS.

Specimens of pharyngeal bones thickly crowded with molar teeth, found in miocene and pliocene formations of Europe and Africa, have been referred by Prof. Igino Cocchi of Florence, to an extinct genus of labroid fishes under the above name. (Monografia dei Pharyngodopilidæ, Firenze, 1864.)

PHARYNGODOPILUS CAROLINENSIS.

Odax carolinensis, Leidy: Proceedings Academy Natural Sciences, 1855, 396.

Specimens of isolated pharyngeals thickly crowded with teeth, resembling those referred to the above genus, are occasionally discovered in the Ashley phosphate beds of South Carolina. Specimens of the kind, together with others of maxillaries and teeth, obtained by the late Capt. Bowman from the sands of Ashley River, were described by me in the Proceedings of this Academy in 1855, under the name of *Odax carolinensis*.

Figure 19, Plate xxxiv., represents an inferior pharyngeal, so closely crowded with teeth that scarcely a vestige of the bone in which they are imbedded is visible. The largest teeth are central and posterior. The original form of the teeth as seen on the masticating surface, would appear to have been hemispherical, but in many cases, from their crowded condition, they have assumed a more or less irregular form. The surface of the pharyngeal bone opposite to the masticating pavement of teeth is crowded with fewer and larger empty cavities of reserve for teeth.

The pharyngeal bone with its imbedded mass of teeth, reminding one of a fused mass of discolored beads such as one occasionally meets with from some burned-down house, is in the shape of a broad triangle with the apex in front and the thickened base directed backward. Prof. Cocchi describes the corresponding bone in a reversed direction from that here given, and which appears to me to correspond with that of the position of the inferior pharyngeal in the Wrasse and the Tautog.

Figure 20 represents another specimen from a smaller individual if not another species. The posterior teeth are much more numerous in the same extent of space than in the preceding specimen, but perhaps this difference would be dependent on difference of age.

Figure 21 represents a superior pharyngeal with its closely impacted teeth. The form of the horizontal section is half crescentic devoid of the point. The larger teeth are internally situated, and the greater number appear on the hinder surface. In the latter position most of the teeth are arranged with more regularity than on the lower surface, or on either masticating surface of the upper pharyngeal.

Prof. Cocchi in his monograph describes no maxillaries referable to *Pharyngodipilus*. Several specimens from the Ashley phosphate beds I have supposed to pertain to the same labroid fish as the pharyngeals above described.

Figure 22 represents a mutilated maxillary with the lower portion retaining the remains of a dental armature. This on the outer surface presents a tessellated appearance as in the Parrot fishes, due to a number of small denticles arranged quincuncially and decreasing in size outwardly. At the margin of the jaw the denticles form a row of compressed ovoid points adapted to biting. Along the symphyseal margin of the jaw there is a single longitudinal row of five conical teeth with an additional pit in advance from which a tooth has been shed. The two teeth in front are double the size of the others.

Figure 23 represents the dental armature of a mandible, with the outer face covered with denticles in quincunx arrangement as in the Parrot fishes. At the biting margin of the jaw a row of denticles forms a serrated edge of compressed ovoid points. Along the symphyseal margin internally there is a single horizontal row of four short conical teeth.

Figure 24 represents another specimen in which the denticles on the outer face of the jaw are more widely separated by intervening cementum. The inner part of the jaw is not so deep or appears less excavated than in the former, and along the symphyseal border there is a horizontal row of five teeth.

EXPLANATION OF PLATES.

PLATE XXX.

Figs. 1-5. Detached beaks of Ziphioid Cetaceans, reduced to one-third the size of the specimens.

1. *CHONEZIPHIUS LIOPS*. Upper view of a detached beak.
2. *CHONEZIPHIUS TRACHOPS*. Upper view of a detached beak.
3. *DIOPLODON PROROPS*. Upper view of a detached beak.
4. Left lateral view of the same specimen.
5. *EBOROZIPHIUS CÆLOPS*. Upper view of a detached beak.
6. *ROSMARUS OBESUS*. Inner view of the left tusk. One-third the natural size.
- 7-11. Teeth of Cetaceans, of the natural size.
7. Tooth resembling those of the Sperm Whales, from the Ashley phosphate beds.
8. Tooth of a similar character, from the same beds.
9. Cetacean tooth, resembling that of a Grampus, from the same beds as the preceding.
10. Cetacean tooth, from the Miocene marl of Nash Co., North Carolina.
11. Cetacean tooth, found with the preceding.

PLATE XXXI.

Figs. 1-3. Right lateral view of the detached beaks of the following Ziphioid Cetaceans, one-third the natural size:—

1. *CHONEZIPHIUS TRACHOPS*.
2. *CHONEZIPHIUS LIOPS*.
3. *EBOROZIPHIUS CÆLOPS*.

All the remaining figures, consisting of the dental armature of Rays, are of the natural size.

- 4, 5. *MYLIOBATES JUGOSUS*. Tooth from Vincenttown, New Jersey.
4. View of the triturating surface. 5. Anterior view of the tooth.
- 6-10. *MYLIOBATES OBESUS*. 6. View of the triturating surface of a median tooth.
7. Posterior view of the same tooth. Specimen from Mullica Hill, Gloucester Co., N. J.
8. Plate consisting of two median teeth, seen on the triturating surface.
9. Posterior view of the specimen. From Vincenttown, N. J.
10. Dental plate, viewed on the triturating surface. From New Egypt, Ocean Co., N. J.
11. *MYLIOBATES FASTIGIATUS*.
- Dental plate, viewed on the triturating surface. From Monmouth Co., N. J.
- 11a. Outline of a transverse section with the crown directed downward.
12. *MESOBATIS EXIMIUS*.
- Fragment of an inferior dental plate. From the sands of Ashley River, S. C.
13. *ÆTOBATIS PERSPICUUS*. Fragment of a tooth. From Monmouth Co., N. J.
- 14-18. *ÆTOBATIS ARCUATUS*, Cope.
- Fragments of teeth, from the miocene of Charles River, Maryland.

14. Left half of an inferior tooth. 15. Median portion of an inferior tooth.
16. Inferior tooth with the left extremity lost.
17. The right portion of a superior tooth.
18. Portion of the left side of a superior tooth.
- 19, 20. *ÆTOBATIS PROFUNDUS*, Cope. Teeth found mingled with the preceding.
 19. An anterior tooth of the lower dental series.
 20. The left portion of a similar tooth.
- 21-37. *ZYGOBATES DUBIUS*. Isolated teeth, from the sands of Ashley River, S. C.
 21. A median unworn tooth, seen on the triturating surface.
 22. Anterior view of the same; the root lost.
 23. Anterior view of a median unworn tooth.
 24. Triturating surface of a worn median tooth.
 25. Anterior view of the same tooth.
 26. Triturating surface of a worn median tooth.
 27. Posterior view of the same tooth.
 28. Triturating surface of a first lateral tooth.
 29. Posterior view of the same tooth.
 30. Triturating surface of a first lateral tooth.
 31. Posterior view of the same tooth.
 32. Triturating surface of a first lateral tooth.
 33. Posterior view of the same tooth.
 34. Triturating surface of a second lateral tooth.
 35. Posterior view of the same tooth; the root lost.
 36. Triturating surface of an external lateral tooth.
 37. Posterior view of the same tooth; the root lost.

PLATE XXXII.

Figs. 1-4 Represent detached beaks of Ziphioid Cetaceans, from the Ashley phosphate beds, one-third the diameter of the originals.

1, 2. *PROROZIPHIUS MACROPS*.

1. Upper view of a detached beak or rostrum. 2. Left lateral view of the same.

3, 4. *PROROZIPHIUS CHONOPS*.

3. Upper view of a detached beak. 4. Right lateral view of the same.

5-7 Represent the dental armature of Rays, of the natural size.

5. *MYLIOBATES SERRATUS*. Inferior dental plate.

5a. Transverse section of the same. Specimen from Pemberton, Burlington Co., N. J.

6. *MYLIOBATES PACHYODON*, Cope. Fragment of an inferior dental plate.

6a. Transverse section of the same, with the crown reversed or directed downward. From the miocene tertiary of Charles Co., Md.

7. *MYLIOBATES*. Portion of an inferior dental plate.

7a. Transverse section of the same. From the same locality as the preceding.

PLATE XXXIII.

Exhibits the dental armature of Rays, with the fore part or worn extremity directed upward.

All of the natural size.

Figs. 1-3. *MYLIOBATES MORDAX*. 1. An inferior dental plate; the right half alone represented.

Specimen from the Ashley phosphate beds.

2. A second specimen, from the same locality.

2*a*. A transverse section of the same, with the crown directed upward.

3. A superior dental plate, probably of the same species. From the same locality.

4. *MYLIOBATES GIGAS*, Cope.

A superior dental plate. From the miocene tertiary of Charles Co., Md.

5. *MYLIOBATES VICOMICANUS*, Cope.

An inferior dental plate. Found with the preceding.

6. *MYLIOBATES FASTIGIATUS*. A superior dental plate.

6*a*. Transverse section of the same, with the crown directed downward. From Monmouth Co., N. J.

7. *MYLIOBATES MAGISTER*.

An inferior dental plate. From the Ashley phosphate beds.

PLATE XXXIV.

Figs. 1, 2. *CERATOPTERA UNIOS*. Figures of the natural size. Bony knob of the tail.

1. Upper view. 2. Lateral view, the hinder extremity directed towards the left.

3. *TRIONYX*. Fragment of a costal plate, half the natural size.

4, 5. *EUPACHEMYS OBTUSUS*.

Figures half the natural size. A marginal bone of the carapace.

4. Upper view. 5. View of the posterior sutural surface; the upper surface of the bone directed towards the left, and the inner margin of the bone upward.

6. *DINOZIPHUS CAROLINENSIS*. A tooth, one-half the natural size.

7. *CETERHINOPS LONGIFRONS*. Upper view of a fragment of the skull, one-half the natural size. The occipital extremity is uppermost.

8, 9. *GRYPHODOBATIS UNCUS*. A tooth magnified two diameters.

8. External or anterior view. 9. Internal or posterior view.

* 10-13. *ACRODOBATIS SERRA*.

Four teeth, viewed on the anterior or external face, magnified two diameters.

10. Tooth with the principal point worn off. 11, 12. Teeth less worn.

13. Tooth retaining its principal point.

14. *ACRODOBATIS OBLIQUUS*.

Tooth magnified two diameters, external view. Specimen from Monmouth Co., N. J.

15-18. *DIDON VETUS*. Dental armature of the jaws, natural size.

15*a*. Dental armature of the lower jaw, viewed on the upper or oral surface.

15*b*. The same specimen seen on the under surface.

16. Dental armature of the upper jaw, viewed on the under or triturating surface.

17. View of the triturating surface of two piles of oral plates from another specimen.

18. View of the upper surface of the same specimen.

19-24. PHARYNGODOPILUS CAROLINENSIS.

Dental armature of the jaws and pharyngeals, magnified two diameters.

- 19. Dental armature of the inferior pharyngeal.
- 20. A similar specimen from another individual.
- 21. Dental armature of a superior pharyngeal.
- 22. A mutilated upper maxillary with part of the dental armature.
- 23, 24. Dental armature of two mandibles, viewed externally.
- 25-30. XIPHODOLAMIA ENSIS. Teeth, of the natural size.
- 25, 26. Two views of a tooth, from Vincenttown, N. J.
- 27. A similar tooth, from Burlington Co., N. J.
- 28. A smaller tooth, from Monmouth Co., N. J.
- 29, 30. Teeth, from Vincenttown, N. J.
- 31, 32. PRISTIS ENSIDENS. Two teeth of the natural size.
- 33, 34. XENODOLAMIA PRÆVUS. Posterior view of two teeth, of the natural size.
- 35, 36. XENODOLAMIA SIMPLEX. Posterior view of two teeth, of the natural size.
- 37-41. SPHYRÆNA MAJOR. Teeth, of the natural size.
- 37. Tooth—probably a lateral premaxillary tooth.
- 38, 39. Lateral mandibular teeth.
- 40, 41. Anterior barbed teeth.
- 42, 43. MEGATHERIUM. A first lower molar tooth, of the natural size.
- 42. Triturating surface. 43. External view.
- 44. MYLIOBATES OBESUS.
- Natural size. Two mutilated median teeth. From Pemberton, Burlington Co., N. J.
- 45. Tooth of a Shark, from the cretaceous formation of Bexar Co., Texas. Natural size.
- Specimen recently loaned for examination by Mr. G. W. Marnock.

Description of a Collection of Fossils, made by Doctor Antonio Raimondi in Peru.

By WM. M. GABB.

SEVERAL years ago Dr. Antonio Raimondi, of Lima, Peru, sent me a fine series of fossils collected by himself during a detailed study of that Republic, and which he assured me, in the accompanying letter, had extended over a period of eighteen years. He desired me to study and describe them; but almost uninterrupted professional engagements have never allowed me time to take them in hand. In the Proceedings of the California Academy of Natural Sciences, 1867, p. 359, I published a translation of a part of Dr. Raimondi's letter, giving a hasty sketch of the geology of the country; and in the American Journal of Conchology, vol. v, p. 25, I published what was intended as the first of a series of papers on the subject; then describing the Tertiary fossils. Since then I have never had the opportunity of resuming the work until now.

So little has been written on South American palæontology that it may be advisable to give here a list of the papers, scattered as they are in books of travel and periodicals, American and European. The following list may not be perfect, but includes all the works I have consulted, and in fact all with which I am acquainted, bearing on the question. I have appended the list of papers, together with as complete a review as possible of the fossils, as an appendix to this memoir, and trust that this work, not the most agreeable in its character, may be of use to those who follow me. In revising the species, I have compared each in a genus with all of its congeners, and have endeavored, so far as the information was available, to revise the generic references. Without specimens, this is of course always unsatisfactory, and, while I have been able to be positive in many cases, there are many others where it was impossible to be accurate. I have been fortunate enough to obtain access to the types of Dr. Isaac Lea's paper in the Transactions of the American Philosophical Society, and thereby correct several errors into which subsequent students have fallen.

PART I. TERTIARY FOSSILS.

The Tertiary fossils were described, as before said, in the American Journal of Conchology. Besides the species mentioned in that paper, there were others, too imperfect for positive determination, except the two following:—

SEMELE SOLIDA, Gray; a cast.

OSTREA IRIDESCENS, Gray; a wide-spread species.

The following forms are here figured for the first time:—

FUSUS PAYTENSIS, G., Pl. 35, fig. 1, 1a; Jour. Conch. v. 4, p. 25.

TRITONIUM PERNODOSUM, G., Pl. 35, f. 2; Jour. Conch., v. 4, p. 26.

EUSPIRA ORTONI, Gabb, Pl. 35, fig. 3.

Ampullina Ortoni, G., Jour. Conch., v. 4, p. 27.

CERITHIUM LÆVIUSCULUM, G., Pl. 35, f. 4; Jour. Conch., v. 4, p. 27.

LITTORINA LAQUEATA, G., Pl. 35, f. 5; Jour. Conch., v. 4, p. 28.

VOLUTODERMA PLICIFERA, Gabb, Pl. 35, fig. 6.

Volutilithes id., Gabb, Jour. Conch., vol. 4, p. 28.

TURRITELLA COCHLEIFORMIS, G., Pl. 35, f. 7; Jour. Conch. v. 4, p. 29.

RÆTA GIBBOSA, G., Pl. 35, fig. 8, 8a; Jour. Conch., v. 4, p. 30.

CARDIUM (LÆVICARDIUM) PERTENUE, G., Pl. 35, f. 9, 9a; Jour. Conch., v. 4, p. 30.

ARCA (SCAPHARCA) RAIMONDII, G., Pl. 35, f. 10, 10a; Jour. Conch., v. 4, p. 31.

PART II. SECONDARY FOSSILS.

In consequence of the scanty stratigraphical information accompanying the specimens, it is in some cases impossible to assign the species to their proper geological horizon with any degree of certainty. I have therefore united all of the undoubted secondary forms in a consecutive series, quoting with each species such information as I possess. Dr. Raimondi gives the altitude at which each was found, and I have in most cases added it, although not a matter of very great interest.

CEPHALOPODA.

AMMONITES, Brug.

A. ATTENUATUS, Hyatt, Pl. 36, f. 1, 1a, 1b.

Buchiceras attenuatum, Hyatt, Proc. Bost. N. H. Soc., v. 17, p. 372.

Shell flattened on the sides and back; whorls increasing somewhat rapidly in size; nodose and marked by obsolete radiating ribs. In the young shell these ribs start on the inner edge of the whorl, in contact with the preceding volution, cross

the umbilical margin and develop into a rather sharp tubercle. From this tubercle they run entire, or branch into two or even three, each ending on the dorsal margin in a small tubercle. As the shell increases in size, the umbilical row of tubercles changes in character, they becoming fewer and much more prominent, and the sides of the shell more convex. Umbilicus nearly a fourth of the diameter of the shell, its margins rounding off with a regular curve into the sides between the nodes. Dorsum* flattened, rendered concave by the two dorsal rows of tubercles which are placed alternately. Aperture subovate, deeply notched by the preceding whorl. Septum comparatively simple, consisting of a dorsal and eight lateral lobes, with their corresponding saddles. The lobes are all small; the dorsal is short and broad, ending in two short branches, with all the teeth of nearly the same size, as are those on the sides of the lobe; the middle space between the branches is about one third of the depth of the lobe, and of an equal width. The entire lobe lies in the space on the dorsal surface between the tubercles. The superior lateral lobe is not more than half the length of the dorsal, very constricted above, and is expanded below into a spatulate form, bordered by six or seven teeth nearly of the same size. The dorsal saddle is divided by a deep notch into two unequal parts, the upper side indented by four teeth, the lower by but one. The first two lateral lobes are, like all the others, of the same shape as the superior lateral, but of twice the size, and end in five bidentate processes. The second and third saddles are notched by one tooth each, the fourth by two, and the others by but one each. The other lobes are of the same general pattern as already described, but diminish regularly in size and become correspondingly more simple in detail, except one on the margin of the umbilicus, which is of the same size as the third lateral.

Greatest diameter, 4.5 inches; greatest width of whorl, 1.7 in.; width of aperture, 1.5 in.; width of umbilicus, 1.0 in.

Locality. Quebrada de Huari, between Morococho and Jauja. "From a bluish calcareous sandstone extensively developed in the Cordillera of the central part of Peru. Jurassic. Height of 3300 metres above sea level." Attached to it in the same block of matrix is a fragment of *Neithea 5-costata*, and a small *Exogyra* (young of *E. polygona*?). The presence of the former shell proves it to be middle Cretaceous.

The present species is of the type of *A. Michelinianus*, d'Orbigny, of the French

* I use the term dorsum, in accordance with the old usage, for the peripheral portion of the shell, although recent research seems to point to this having really corresponded with the abdominal aspect of the animal. In doing so, I have no other defence to offer than that this entire paper has been written some time, and before the publication containing these new views reached me.

Gault, but has a very different septum; the tubercles on the dorsal angles are more numerous and alternate instead of being opposite, and on the sides the tubercles are fewer and more isolated. It also has fewer ribs. I sent this shell, with several other doubtful Ammonites, to Prof. Alph. Hyatt, who has named a number of species of the genus from South America. His descriptions are, however, so unsatisfactory that, as in this and the other cases where I have his species, I was unable to identify them. For this reason, therefore, I do not hesitate in re-describing the species and figuring it, so as to enable those who follow us to better recognize it. His note accompanying the specimen is as follows: "This is my *Buchiceras attenuatum* from Celedin, Peru, but the specimens described by me were smaller and younger." There are some strongly-marked points of difference between my specimen and the few characters pointed out by Prof. Hyatt, but he seems to consider them the results of difference of age.

In not following Hyatt, Waagen, and others in the generic subdivisions of the *Ammonites*, I must admit that I am not yet convinced of the utility of the proposed genera. In the present state of zoological classification it has become clear that trenchant generic, or even specific, lines cannot be drawn; in other words, with full series of specimens, genera and species resolve themselves into convenient groups, between which transitional forms occur. A genus can no longer be considered "a group of species, having a series of characters in common, and by which it can be distinguished from every other group." Rather, it is a group of species, most nearly allied to some one typical form—in short, a pure matter of convenience—and since ideas can only be expressed by words, these groups must have names which, for convenience, we call generic names. Now, in the *Ammonites* it may be very well to group the species together, and sections in the genus, whether known as "sections," "sub-genera," "groups," or what not, are undoubtedly useful; but it seems to me unnecessary to burden our already ponderous nomenclature with perhaps a hundred more names, when one will suffice. The transitions from one of the new genera to another are so gradual, so minute and perfect, that they unnecessarily increase the labor of the student, instead of simplifying it; and the prime object of classification is to obviate this. The best proof of this last assertion is that no two of the leaders of the new system agree on the course to pursue, or on the limits of the genera proposed. I might add much with reference to the genera of the *Ammonitidæ*, based on the manner of coiling. It is generally recognized that these genera are purely artificial, and that species are well known, especially in Europe, belonging at the same time to several genera. But this subject is foreign to the present paper, and I know that it is in better hands than

my own. I trust that before long the studies of Prof. Hyatt on this question will be published.

A. Sp. indet. Pl. 36, f. 2.

A single specimen, too imperfect for detailed description. The shell is allied to *A. Renauxianus*, d'Orb., and *A. cultratus*, d'Orb. of the Neocomien. It is more strongly carinated on the dorsum than the former, and the ribs, instead of being bifurcated from a tubercle as in that species, are large and single. In this last respect, as well as in the rib being more acute, it differs from the latter.

Locality. From the "Cerro de Potosi." From the calcareous sandstone which overlies the limestone of the Cerro of San Antonio; near the silver mines; height 4200 metres.

The geological age is not stated, but the type of the species indicates either the jurassic, or a horizon very low in the Cretaceous.

A. AEGOCEROS? Phil. Pl. 36, fig. 3, 3a, 3b.

A. aegoceros, Phil., Viaje Atacama, p. 142, pl. 2, f. 2, 3.

Shell many whorled; whorls regularly rounded on the back and sides; umbilicus wide; aperture subcircular. Surface marked by numerous, small, acute ribs, which begin on the inner margin, and cross the dorsum; these ribs arch slightly forward on the middle of the side and on the dorsum. Most of them bifurcate in the middle, though an occasional one, placed at irregular distances, remains entire. In some cases, instead of branching, there is a secondary rib interpolated, its inner end not uniting with that on either side. Septum unknown.

Locality. On the label, with a corresponding number, one specimen is referred to the Hacienda of Macanga, Prov. of Pataz; but the accompanying catalogue, as well as the label on another specimen with the same number, gives "between the Pueblos of Huandoval and Corongo, Prov. of Conchucos, jurassic." The latter is more probably correct, since there are other fossils from the former locality, and their lithological character is entirely different.

Remarks. The species is nearest to *A. annulatus*, Sby. of the Lias, and *A. biplex*, Sby. of the Oxford. From the former it differs in the ribs being fewer, larger, and in being arched, instead of straight, and in more of them branching. The cross section of the whorl is also much more nearly circular. In this last respect, it also differs from the latter, as well as in having the ribs smaller and more numerous. I have referred the species to Philippi's name doubtfully, since the ribs on his figure seem to be straighter, but the figure is evidently badly drawn, and the difference is too slight to warrant a separation.

A. HYATTI, n. s., Pl. 37, fig. 1, 1a.

Shell sub-globose, whorls increasing rapidly in size, rounded; umbilicus small, umbilical face of the whorl vertical, margin rounded, sides very slightly converging, dorsum regularly rounded; surface smooth, or only marked by indistinct lines of growth, which bend forward on the inner margin of the whorl, slightly backwards on the middle, and then forward towards the dorsum. Septum unknown.

Measurements. Diameter, 4.5 in.; diameter of umbilicus, 0.7 in.; height of body whorl, 2.1 in.; width of aperture, 1.75 in.

Locality. "Near Canibamba, Prov. of Huamachuco. The rock contains coal. Height 3500 metres."

Remarks. Closely allied to *A. Sutherlandiæ*, Murch., but differs in not narrowing so rapidly towards the dorsum, and in the absence of ribs on the young shell. The surface of the only specimen is well preserved, but the thin shell will not separate from the interior to expose the septum.

A. RAIMONDIANUS, n. s., Pl. 37, f. 2, 2a.

Shell varying greatly between the young and the adult form; flattened discoidal, broad on the dorsum; sides nearly parallel; whorls increasing very gradually in size, enveloping about a third of their width; umbilicus broad, open. Young shell strongly ribbed; ribs of the same size as the interspaces, showing a tendency to be slightly tuberculated on the umbilical angle, beginning at the extreme inner edge of the whorl, in contact with the preceding volution, passing vertically out of the umbilicus, they are inclined very slightly forwards on the sides of the whorl, and, on approaching the dorsum, bend with a short curve strongly forward, producing a slightly rounded, acute angle on the median dorsal line. As the shell grows older the ribs disappear, when it acquires a diameter of about four inches. On the largest specimen, 9 inches in diameter, they are represented by faint undulations ending in an obsolete tubercle on the angle of the umbilicus. The dorsal tongue is also broadly rounded instead of being sub-angular.

Measurements. Diameter, 9 inches; diameter of umbilicus, 3.5 in.; width of whorl, 3.5 in.; width of aperture, 1.9 in.

Locality. "Cerro del Salto del Frayle (or friar's leap), near Chorillo, 3 leagues south of Lima. Same rock as that on the Island of San Lorenzo. But a few metres above the sea." Dr. Raimondi considers this *lias*.

Remarks. Of the type of *A. cymodoce*, d'Orb, from the Coralline and Kimmeridge, but differs in having smaller ribs, fewer whorls, and in the strong flexure of the ribs, and lines of growth on the dorsum.

A. CORNIFERUS, n. s., Pl. 38, fig. 1, 1a.

Shell flattened and converging on the sides, and flattened and grooved on the dorsum; whorls enveloping nearly one-half; umbilicus moderate; aperture nearly twice as broad at its widest part (across the dorsum of the enveloped whorl) as at the top. Surface marked by dichotomous ribs, which run from the umbilical margin and branch about the middle of the side. At the point of division, there are tubercles on some specimens, which are, however, absent on others. From this point they arch forward with a slight and regular curve, bearing (or not, according to variation) a slight tubercle on the dorsal margin. In one case, between each pair of bifurcated ribs, there is a supplementary rib interpolated, beginning on the line of division, and continuing to the margin, in all respects like the branching rib. From the mould in the matrix, it can be seen that the ribs were acute, and the tubercles were armed with spines. In one specimen there is no trace of ribs crossing the dorsal groove; in another it is crossed by obsolete ribs, while in a third they are as well developed here as on the sides. Septum unknown, beyond the fact that it consists of a dorsal lobe, two large ones on the sides, a large ventral, and some small details about the umbilical angle.

Measurements. Greatest diameter, 3.0 in.; width of body whorl, 1.4 in. (approximate); greatest width of aperture, 1.1 in.; width of the aperture at the dorsum, 0.6 in.

Locality. "Five leagues southeast of the village of Recuay, Dept. of Huaraz. Height 3500 metres. Jurassic."

Remarks. Three specimens imbedded in calcareous nodules, from which it is impossible to extract them, so as to show satisfactorily the umbilical region. The species is nearest allied to *A. Garantianus*, d'Orb., of the Lower Oxford, but differs in having a broad, regularly concave groove on the dorsum, and in the shape of the cross section of the whorl. In one shell the greatest width is below the middle of the aperture, above which there is a rapid convergence of the sides. There are also other minor differences in the details of ornament, especially in the presence of spines, and the sharper ribs in one shell.

A. CARBONARIUS, n. s., Pl. 38, fig. 2, 2a, 2b.

Shell large, flattened discoidal, slightly convex on the sides, converging rounded towards the dorsum, which is acute; whorls deeply enveloping; umbilicus small. There is very little difference in general appearance between the young and adult shell, the characteristic markings on a shell of 0.75 inch in diameter being proportionately stronger, but exactly like one of nearly 8 inches across. Surface marked by numerous regular ribs, slightly flattened on their upper surface, and

with concave interspaces nearly as large as the ribs. These begin at the suture, inside of the umbilicus, are inclined slightly forward, flexed, and near the dorsum are bent forward with a broad gentle curve, terminating against the sharp dorsal carina. Aperture elongate ovate; septum unknown. The greatest change that occurs with age in this species is in the dorsal carina. As the shell grows older, this becomes higher and narrower until it assumes the character of a prominent plate. The ribs disappear as they reach its base. See Figure 2 b.

Measurements. From a small specimen. Greatest diameter, 2.9 in.; length of aperture, 1.4 in.; width of aperture, 0.45 in.; height of aperture above the dorsum of preceding volution, 1.0 in.

Locality. From the Liassic (?) coal mine of Pariatambo, associated with *Myophoria*, and other characteristic forms. Also from the "Cerro de la Ventanilla," at a height of 5000 metres.

Remarks. From *A. primordialis*, Schlot., of the Upper Lias, this shell differs in being less acute on the dorsum, in having a smaller umbilicus, and more flexed ribs. It is more convex than *A. complanatus*, Brug., of the same formation, and the ribs want the backward flexure of that species. In both these respects it also differs from *A. discoides*, Ziet., also an Upper Lias shell. The surface markings are not unlike *A. (?) Peruvianus*, Von Buch, a Cretaceous fossil, probably not an *Ammonite*, since the whorls do not seem to envelop their predecessors. The present species is deeply enveloping. In Von Buch's figure, too, the ribs are represented as twice as wide as those of our fossil.

A. BILOBATUS, Hyatt, Pl. 38, fig. 3, 3a, 3b.

Buchiceras bilobatum, Hyatt, Proc. Bost. N. H. Soc. vol. 17, p. 370.

Shell broad, robust, whorls increasing rapidly in size, and deeply enveloping; umbilicus deep, less than a third of the diameter of the shell; sides flattened and slightly converging; dorsum broad, flattened, and bearing a broad, but not high, median ridge; aperture nearly square with the corners rounded and the dorsal face a trifle the narrowest. Surface marked by a few very large ribs beginning just inside of the umbilical angle, slightly tuberculated on the angle and running to the dorsal margin, where they carry another small angular tubercle. An occasional supplementary rib is interpolated on the dorsal half of the side. Septum consisting of a dorsal lobe, two laterals on the side of the whorl, and two on the umbilical face. Dorsal lobe broad and short, and lying between the two rows of tubercles; at the corners it ends in two short slender branches, simple on their inner face and tridentate outside; between them is a broad emargination, its base nearly straight, and bearing six small teeth; above the branches are two large

teeth on each side. Dorsal saddle broad, almost without indentations, except a tongue which divides it into two unequal parts, the larger being on the dorsal side, the smaller is unsymmetrical, sloping down obliquely to the superior lateral lobe, which is broad, short, and unsymmetrical. At its termination it is divided into two branches, of which the upper is narrow and obscurely tridentate; the lower is divided into one simple and one bifurcate prong, all of the same length; above the terminal branches the lobe bears a large tooth on the upper side, and a small one on the lower. The lateral saddle is a repetition, on a smaller scale, of the preceding. The inferior lateral lobe is not more than half the size of the superior, and shows only the rudiments of the same details, in the shape of three minute teeth on the end. The inferior lateral saddle, bending round the umbilical margin, is straight above, divided like the others into two unequal parts, of which the largest is on the upper side, but, instead of the tongue, the division is produced by two little teeth; the upper part is further subdivided by another tooth. The first lobe inside of the umbilicus is a mere bidentate tongue, with a little tooth on the upper side; the second lobe is still more rudimentary, and is partly hidden by the suture; the included saddle is irregularly divided into three parts by two teeth.

Measurements. Greatest diameter, 3.0 in.; diameter of the umbilicus, 0.8 in.; depth of umbilicus from the inner angle of the mouth, 0.8 in.; width of body whorl, 1.4 in.; greatest width of mouth, 1.5 in.; width of mouth at the dorsal side, 1.1 in.; depth of emargination of the ventral side of the mouth, 0.3 in.

Locality. From the "Quebrada de Colpamayo, in the immediate neighborhood of Chota, Dept. of Cajamarca. Height 2000 metres. Cretaceous?"

Remarks. From the type of the shell, I agree with Dr. Raimondi in believing this to be a Cretaceous species. Its septum is remarkably simple, but, at the same time, its simplicity has nothing that would suggest or approach to *Ceratites*. It is rather that usually observed in a young *Ammonite* that has not yet developed its details, although my specimen, as will be observed above, is 3 inches in diameter. Prof. Hyatt's note, on returning me the specimen, is: "This is undoubtedly my *Buchiceras bilobatum* from Cachiyacu, but is an older specimen than that described by me."

A. OLLONENSIS, n. s., Pl. 38, fig. 4, 4a.

Shell discoidal, compressed, umbilicus small, shallow; sides converging with a gentle curve; dorsum narrow, slightly concave. Sides slightly undulated by very broad rudimentary ribs; a row of small tubercles on the umbilical margin, and numerous small compressed tubercles bordering the dorsal margin, which are

thereby rendered subacute and undulated. Aperture long and narrow, widest in the middle. Septum composed of numerous small lobes and saddles, apparently about six lobes on the sides. The dorsal (or as it might perhaps more properly be called, the abdominal lobe) is small, and lies entirely on the dorsal surface; the superior lateral lobe is much smaller than the second, from which the others diminish regularly in size. The saddles are all comparatively simple except the first, which is unequally divided.

Measurements. Greatest diameter (apparently), about 3.5 in.; greatest width of body whorl, about 1.75 in.; greatest width of aperture, 1.0 in.

Locality. "Immediate vicinity of Ollon, Prov. of Cajatambo; height 3000 metres. This rock appears to be Cretaceous." (R.)

Remarks. Described from two fragments, one consisting of the body chamber only, showing the broken remains of the first septum, a trace of the umbilical margin, but a very good surface, although somewhat broken about the lower part of the mouth. The species may be compared with *A. placenta*, DeKay, of the Cretaceous of the United States, from the flat-backed variety of which it differs in the dorsum being much wider, and bordered by tubercles instead of a smooth keel. The ventral row of tubercles, of which traces remain in our specimen, is also wanting in that species. From *A. Pedernalis*, Von Buch, which is sometimes undulated on the sides, it also differs in all the above characters, and in the ventral half of the sides not sloping down so gently to the umbilical margin. Prof. Hyatt returned me the specimen figured, with the note following: "This I should consider a variety of *Buchiceras attenuatum*, something between the form described by me and that belonging to you (see figure of *A. attenuatus*, W. M. G.), see sutures. It may be different, however, since I think I have seen Texas specimens like it, and smooth throughout, A. H." I hardly feel warranted, however, in accepting my friend's idea in this case, and venture to name the form. My reasons for separating it are, from the (imperfect, it is true) view of the septum, obtainable on the broken face, there seem to be fewer lobes than in Hyatt's species. This specimen is nearly as large as the other, and it has developed in a markedly different manner; the entire cross section of the whorl differs; there is no trace of tubercles on the sides of the volutions, and the little tubercles on the umbilical margin in this, are unrepresented in that.

A. MACROCEPHALUS, Schlot., Pl. 39, fig. 1, 1a.

Shell globose, sides and dorsum rounded; sides converging very slightly; umbilicus minute; whorls very deeply enveloped, the last almost entirely hiding the preceding; surface ornamented by small regular ribs, which arch forwards a

little on the middle of the sides, and then cross the dorsum continuously. These are rarely branched, but one or even two supplementary ribs are interpolated on the dorsal half of the shell.

Measurements. Greatest diameter, 2.05 in.; greatest width of body whorl, 1.1 in.; width of mouth, 1.3 in.; height of aperture from dorsum of included whorl, 0.65 in.

Locality. "Province of Tarapaca, in the south of Peru." Jurassic. This is evidently a stray specimen, since there is no exact locality given, nor the altitude, nor yet even a guess at the geological age. This shell, also reported from Chili and Bolivia, is of especial interest, since it assists us to fix the horizon of what seems to be an important formation in the Andes.

A. ACUTISSIMUS, n. s., Pl. 36, fig. 4, 4a.

Shell discoidal, sides compressed, dorsum expanded and acute; whorls slightly convex on the sides, and marked by two rows of large rounded nodes, one near the umbilical margin, the other towards the dorsum. These nodes are placed so that the outer and inner row alternate, and they are connected with each other by broad, faint undulations. Above the outer row of nodes the sides are concave. Septum unknown.

Measurements. Width of body whorl, 1.1 in.; width of aperture, 0.5 in.

Locality. "Ridge of the three crosses, between Huallanca and Aguamiro; Prov. of Huamalies. Height more than 4000 metres. From a pulverulent carbonate of lime that appears to be Cretaceous."

Remarks. This description is from a single small fragment, so imperfect that I should not have felt warranted in describing it, were it not of so marked a form as to run little risk of being mistaken. Its knife-like dorsum and the broad nodes on the sides are characters which will separate it at a glance from any species known to me. Hyatt says of it: "If this is from the Cretaceous, it may be closely allied to my *Buchiceras serratum*, but it is not probably the same."

A. VENTANILLENSIS, n. s., Pl. 39, fig. 2, 2a-d.

Shell flattened discoidal; back broad, whorls increasing very gradually in size, but slightly enveloping; aperture subquadrate; umbilicus broad. Very young shell smooth, without ribs, sides rounded, back with a small median keel, and each whorl enveloping about half of its predecessor. At a little over an inch in diameter, the shell acquires large rounded plain ribs, the tubercles beginning to appear on the fifth or sixth rib. In the adult individuals, with the volutions nearly two inches wide, the surface characters are entirely different. The umbilical margin is rounded, and gives rise to numerous, closely placed, rounded ribs, starting

with a marked inclination backwards; these afterwards curve forwards on the lower half of the whorl, from the middle continue transverse to the dorsal angle, and then incline strongly forward, forming an acute angle between the two sides against a large median dorsal keel. At the dorsal angle each rib is developed into a large flattened tubercle placed at an angle of about 45° to the corresponding one on the opposite side. Below this large tubercle, on each rib, is a smaller one, placed on the middle of the upper half of the side of the whorl. Septum unknown.

Measurements. Height of aperture, 1.5 in.; width of aperture, 1.1 in.

Localities. Liassic; one adult fragment from the "limestone of the Cerro del Ventanillo, between Pachachaca and Jauja. Height of 5000 metres." Another, and a very young shell, from the "coal mine of Pariatambo, 5 leagues from Morococho. Height 4000 metres." Dr. Raimondi considers both these localities Jurassic, and remarks of the former that the formation is very extensive. Still another specimen, a little over an inch in diameter, is from the "neighborhood of Fingo, Prov. of Huari, Dept. of Huaraz, from a schist containing coal."

Remarks. Our species is very closely allied to the Liassic form, *A. spinatus*, Brug., and may eventually prove to be identical, since they only differ in details of ornament, both going through the same series of changes from youth to the adult stage. In the specimens before me, however, the characters on which I have depended for a separation are constant. There is a broad concave space on each side of the keel, between it and the tubercles, the space between the outer sides of which is almost as great as the greatest width of the aperture. In *A. spinatus* these tubercles are placed entirely on top, and the second row, which in our shell is well down on the sides, forms the outer margin of the dorsum in that. Further, in our shell the ribs on the ventral half of the whorl are markedly flexuous, while in *A. spinatus* they are straight.

A. GIBBONIANUS, Lea, Tr. Amer. Philos. Soc., 2 S., vol. 7, p. 254, pl. 8, f. 3.

A single fragment, not more perfect than Mr. Lea's specimen, occurs in the collection from "between Huandoval and Corongo." It shows no additional characters, being a piece of one whorl, about as long as broad, and having but four ribs and part of another. It is more convex in its cross section than the form figured by Marcou. Mr. Lea's original, now in the museum of the Academy of Natural Sciences, although weathered on one side, shows that it had a rounded dorsum. The shell from Texas referred to this species by Marcou (Geol. of N. A., p. 35, pl. 2, f. 2), has an acutely carinated dorsum, and the ribs are acute, while the South American has rounded ribs. These ribs in *Gibbonianus* run all of the way to, and apparently cross the dorsum. In the Texan they stop short. The

cross sections of the whorl differ markedly, though no specimen, I have seen, of *Gibbonianus* shows an entire section. Enough, however, is known to show that the umbilical margin is deep, and nearly at right angles to the side of the whorl.

A. ANDRÉ, n. s., Pl. 39, fig. 3, 3a, 3b.

Shell discoidal, very convex in the middle and compressed on the dorsum; whorls entirely enveloping; umbilicus minute, deep; aperture broadly cordate, deeply emarginate on the ventral side. Surface marked by strong lines of growth, slightly sinuous on the sides and arching strongly forwards close to the dorsum. Besides these, on the dorsal half of the side are obsolete ribs, and near the margin a row of barely perceptible tubercles. Septum consisting of a dorsal and three lateral lobes. The dorsal lobe is large, broader above than below, and ends in a slender branch on each side, bearing one digitation on its inner side and two on the outer; above this, at the base of the lobe, is a long, narrow tridigitate branch. The adjoining saddle is very oblique, and is unequally divided by a large tongue. The superior lateral lobe is small and narrow, ending in an oblique branch bearing three teeth on its lower side and one longer process on the upper; above it, on the body of the lobe, are two processes on the upper side, and one more complex on the lower. The next saddle is oblique, higher on the lower side and indented by three teeth of unequal size. The inferior lateral lobe is small, and is divided into three bidentate branches of nearly equal size. The next saddle, occupying the curved surface adjoining the umbilicus, is nearly straight, divided in the middle by a small tongue, the upper half again subdivided by a smaller tongue. Up to this point the septa continue entirely separate, but the next lobe, lying on the umbilical face, is very broad, divides into three broad branches, some of the points of which are obliterated by abutting against the last saddle of the preceding septum.

Measurements. Greatest diameter, 2.5 inches; greatest width of aperture, 2.0 in.; greatest width of body whorl, 1.6 in.; height of aperture from the dorsum of the preceding whorl, 1.0 in.

Locality. "Province of Pataz; Dept. of Libertad; height, 3000 metres."

Remarks. In his notes, Dr. Raimondi considers the formation Cretaceous, but we have in this single fossil a sufficient proof of its being Jurassic. The specimens are in a beautiful state of preservation, and come from a light-colored, crystalline limestone showing every detail in perfection. The species belongs to the group of which *A. cordatus*, Sowerby, is the type. It resembles that shell in external character to some extent; so much so that I should have probably hesitated in separating it, had I not possessed the details of the septum. In this, it differs alike

from all the known species of the group. The inferior lateral lobe is entirely unlike that of *A. cordatus*, as is all the remainder of the septum to the suture; and the resemblances in the dorsal and superior lateral lobes are very remote. From the North American *A. cordiformis*, Meek and Hayden, the differences of the septum are still greater; besides which, the only known specimen of that species is strongly costate on the surface, and much more compressed, although these external characters might be only individual in character. Prof. Hyatt, to whom I sent the specimen figured, returned it to me labelled *cordatus*, but I suspect he did not compare the septa of the two forms.

GASTEROPODA.

PERISSOLAX, Gabb.

P. TROCHOIDES, n. s., Pl. 39, fig. 4.

Shell trochiform, spire low; body whorl convexly flattened above and sloping; below, it slopes rapidly inwards; aperture broad, irregularly rounded subquadrate; canal produced.

Locality. Hacienda of Macanga; Prov. of Pataz. Cretaceous.

Remarks. I have ventured to describe this species from a couple of casts, retaining all the parts except the long slender canal, characteristic of the genus. They retain no part of the shell, but show traces on the broadest part of the whorls of three or four revolving ribs. This species is allied to *P. longirostris*, d'Orb., sp. (*Pyrula*), Amer. Merid., p. 119, Pl. 12, fig. 13; Voy. Astrolabe and Zélée, Pl. 4, f. 30; but in that species, as well as in *P. Hombroniana*, the body whorl is broader and rounder, while in ours the greatest width is near the upper angle.

Indet. Several other casts from the same locality occur in the collection. They are from a buff-colored limestone, but none show specific characters; and, in most, even the means of determining the genus is lost.

GYRODES, Con.

G. CONTRACTA, n. s., Pl. 39, fig. 5, 5a.

Shell small, subglobose, oblique; spire low, whorls five, flattened and faintly channelled above; suture distinct and bordered by a slight thickening of the succeeding whorl; body whorl most convex in the middle, contracted in advance; umbilicus open, but unusually narrow; aperture nearly semicircular, with the inner margin vertical, and subangulated above by the flattened top of the whorl; lips simple. Surface marked by very oblique lines of growth, which are most

pronounced on the upper surfaces, near and adjoining the suture. Towards the base there are a few very faint rudiments of revolving lines.

Figure. Somewhat enlarged.

Locality. Liassic coal mine of Pariatambo; and from the elevated table-land two leagues from Cajamarca.

Remarks. This shell possesses remarkable interest from its being the first species of its group of Naticas, found outside of the Upper Cretaceous. Its evidence, however, of a Cretaceous age of the deposit is counterbalanced by the presence of *Myophoria* and by the close relationship of the associated *Ammonites* to Liassic types. While possessing every character essential to the genus, of which I am acquainted with almost every described species, it differs from its congeners in having the characteristic umbilicus, but unusually narrow; an amount of difference that is not surprising when we consider the difference in geological age.

G. LIRATA, n. s., Pl. 39, fig. 6, 6a.

Shell subglobose, large; spire elevated; whorls broadly convex, but very slightly oblique, somewhat flattened on the top and regularly rounded on the sides; umbilicus patulous; aperture not very oblique. Surface marked by about five slightly raised revolving ridges crossed by well-marked lines of growth.

Figures. Natural size.

Locality. "Near Ollon, Prov. of Cajatamba. Height more than 3000 metres." Cretaceous.

Remarks. One of the largest species of the genus yet discovered. It is at once distinguished by a character, rare in the family—surface sculpture. One or two species of *Gyrodes* are crenate on the upper or lower margin of the whorls, but this has distinct revolving ridges placed at about equal distances over the whole surface. The only specimen is a cast retaining enough of the shell to show all of the specific characters except the details of surface adjoining the suture. The cast shows that the upper part of the whorl was more or less flattened, but does not show if the margin of the flattened space was acute, rounded, or crenate. The internal mould shows no trace of the surface ridges.

PRISCONATICA. N. Gen.

Among the earlier forms of Naticas (those of the Secondary rocks) is a large group that has been described, almost without exception, under the vague generic title of *Natica*. They are characterized by being almost always of large size, including several of the largest known species of the family; by their thin shells, generally elevated spire, increasing rapidly in their axial length, rather than

obliquely; with very small, or entirely obsolete, umbilicus, and in having the columellar lip always thinly encrusted. In many respects they approach *Amauropsis*, but they are more naticoid in style, rarely so elongate, and never have the spiral sculpture, often found in that genus. *Ampullina*, Faujas, 1803, of which the type is *A. fluctuata*, is a heavy shell, with a peculiar incrustation of the inner lip, the callus blending gradually into the outer surface. *Ampullina*, Lam., 1813, was proposed for the thin shells, with more or less of a carina bordering the umbilical region, and which he had previously included in the fresh-water genus *Ampullaria*. For this genus the name of *Euspira*, Agas., 1837, must be used, the type being *Ampullaria sigaretina*, Min. Conch., Pl. 283, figs. 1-3. *Globularia*, Swainson, 1840, is also a synonym of this genus. Stoliczka, in Pal. Indica, incorrectly places some species of our new genus in *Ampullina*. *Natica Pedernalis*, Roemer, Kreidebildungen von Texas, may be taken as our type. A better figure than Roemer's will be found in the Palæontology of California, vol. ii. Pl. 35, f. 3.

P. OVOIDEA, n. s., Pl. 39, fig. 7.

Shell large, ovate, thin; spire moderately elevated, whorls about five, sloping above, not very convex; suture small; body whorl broadly convex, somewhat oblique; mouth sub-ovate, oblique, acute behind, broadly rounded in advance; inner lip encrusted by a thin layer. Surface marked only by lines of growth.

Measurements. Length, 3.3 in.; greatest width of body whorl, 2.4 in.; length of aperture, 2.5 in. The above measurements, except the width, are only approximate, since the extreme apex and the end of the aperture are imperfect.

Locality. Neighborhood of Ollon; from a dark bluish limestone, different from the matrix of the other Ollon specimens. Cretaceous (?).

Remarks. This species is nearest to *P. Pedernalis* in form, but is more slender and less oblique; the spire is lower than *P. prægrandis* (*Natica id.*, Roem.), also from the Cretaceous of Texas, and probably Northern Mexico. It is of the type "*Natica*" *Elea*, d'Orb., of the French Jura, at least so far as can be ascertained from the back view given by d'Orbigny, but its spire is much lower. There is no described species in South America approaching it in size, except *P. prælonga* (*Natica*, Seym.), from Brazil, Columbia, and France, and this has a spire as long as the body whorl.

P. INCONSPICUA, n. s., Pl. 39, fig. 8.

Shell small, elongate ovate; spire very high; whorls five and a half; rounded; upper surface rounded, sub-truncate; body whorl broadly rounded in the middle, sloping inwards below; aperture sub-circular; umbilicus absent, or very small; inner lip very thinly encrusted. Surface smooth.

Figure. Magnified to twice natural length.

Locality. Broken from the same block with the preceding.

P. AMPLA, n. s., Pl. 40, fig. 1.

Shell large, unusually short and broad, spire elevated; whorls about six (?), flattened on top, and convex in the middle; suture channelled; aperture proportionately small, oblique, equally broad above and below.

Figure. Natural size.

Locality. Between the River Chonta and the village of Baños; Prov. of Huamalies; apparently Cretaceous.

Remarks. There is but a single cast of this species in the collection, showing nothing of the surface; but the outline of the shell is so strongly characteristic, that I have not hesitated to name it. Its high spire and broad whorls are sufficient to separate it from every species I have ever encountered. The details of surface about the umbilical region are destroyed, but the cast shows enough to demonstrate that the shell was nearly imperforate, and that the inner lip was but thinly encrusted.

This is apparently the shell figured in Wilkes' Expedition Report, Pl. 15, fig. 3a, b, under the name of "*Turbo sp.?*"

TURRITELLA.

T. RAIMONDI, n. s., Pl. 40, fig. 2.

Shell long, slender, many whorled; whorls flattened on the sides, and marked by four beaded ribs, the upper one of which forms the upper margin of the whorl; between these are concave interspaces, marked by fine elevated lines; the lower angle of the body whorl is marked by a plain, sharp, linear rib, which, in the preceding volutions, forms the sutural margin. On the under surface of the last whorl there is a second plain rib of equal size, parallel with the first, and three or four smaller, between which are others still finer. Under surface of body whorl slightly concave. Outer lip broadly and sub-angularly emarginate in the middle, and produced below.

Measurements. Diameter, 0.2 in. Total length probably about 1.5 to 2.0 inch.

Locality. From the Liassic (?) coal mine of Pariatambo.

Remarks. Associated with the fragments from which this species is described, is another single piece of three volutions, which differs from the typical form in the same manner as occurs in other beaded *Turritellas*, markedly so in the case of *T. seriatim-granulata*, Roem., of the Texan Cretaceous. The entire surface is covered with coarsely beaded ribs, six in number, so closely placed as to leave no

concave interspaces, and consequently no room for the finer linear markings described above.

T. PERUANA, n. s., Pl. 40, fig. 3.

Shell moderate in size, long, slender, many whorled; whorls flattened on the sides, or very slightly concave, sloping outwards below; top flattened, narrow and sloping; surface marked by three large revolving ribs, one on the upper angle, one in the middle, and the last near the base; basal margin angular; base slightly convex; outer lip deeply and roundly emarginate above, produced towards the base.

Measurements. Length of three whorls, 0.75 in.; width of body whorl, 0.25 in.

Locality. From the hacienda of Macanga, Prov. of Pataz. Cretaceous. Associated with the *Perissolax trochoides* and *Niethea quinquecostata*.

TYLOSTOMA, Sharpe, 1849.

Varigera, d'Orb., 1850.*

T. MUTABILIS, Gabb, Pl. 40, fig. 4, 4a.

T. mutabilis, Gabb, Palæontology of California, p. 261, Pl. 35, f. 6.

Shell subglobose, spire high, whorls six or seven; body whorl most convex above the middle; varices oblique, large; aperture elongate-ovate. Surface unknown.

From near the ruins of Cuelapo, twelve leagues from Chachapoyas and "hacienda of Uchupata, Province of Huari, height of 2000 metres." Cretaceous.

Remarks. Described from casts retaining almost none of the shell. Found associated with *Echinus Bolivari*, d'Orb. The specimens are all more or less distorted, but I cannot find, in the absence of surface characters, any on which to separate this from the shell described by me under the above name from Mexico.

CINULIA, Gray.

C. ANTIQUA, n. s., Pl. 40, fig. 5, 5a.

Shell ovate, convex; spire high; whorls broadly and regularly convex, outline of one side of the body whorl nearly a perfect segment of a circle; suture impressed; surface marked by about twenty regular equal rounded ribs with smaller interspaces. Aperture elongate, narrowed behind; outer lip very much thickened by a strong marginal rim; details of inner lip unknown.

Measurements. Length, 0.43 in.; greatest width, 0.25; length of aperture, 0.32 in.

* Although d'Orbigny claims the date of 1847 for this genus it cannot be allowed, since it was only indicated by name without a recognizable description in the Prodrôme, and his first full description was published in 1850; while Sharpe had already characterized the genus a year previously.

Locality. Cerro del Ventanillo, between Pachachaca and Jauja, associated with *Ammonites Ventanillensis* and *Petropoma Peruanus*, both of which occur at the Liassic (?) coal mine of Pariatamba.

ACTÆONELLA, d'Orb.

A. OVIFORMIS, n. s., Pl. 40, fig. 6.

Shell thick, ovate, a little narrower below than above; spire slightly elevated; body whorl broadly and regularly convex, narrowing in advance; aperture narrow above, below broader; inner lip encrusted and with three large folds in advance, the middle of which is narrowest and highest. Surface smooth; marked only by lines of growth.

Locality. From a gray crystalline limestone in the neighborhood of Ollon. Cretaceous.

Remarks. The species is described from a somewhat imperfect specimen, the fractures of the matrix having crossed the shell also, and broken away parts. The extreme apex is hidden and most of the aperture wanting, though the cross section of the cavity gives its shape. It is nearest in form to *A. gigantea*, d'Orb., but it has a higher spire and is more convex on the sides and not so acute anteriorly.

PETROPOMA, N. GEN.

Shell trochoid; spire more or less elevated; umbilicus small or imperforate; inner lip encrusted on the body whorl and slightly thickened on the umbilical margin, not toothed; aperture subcircular. Operculum multispiral, subcircular, thick, slightly conical externally and showing the volutions; internally each volution is expanded on its inner margin so as to cover all the surface except a little central pit.

The general character of the shell is such that it could, except for the operculum, have been referred to the genus *Gibbula*, perhaps more properly coming into the sub-genus *Forskälia* of H. and A. Adams, in consequence of the flattened sides to the whorls in the species before us. But like most, if not all the other described Trochoids, that genus is characterized by a horny operculum. In ours it is fully as massive as the shell, and its obliquely truncated margins show that it probably did not possess even a corneous expansion. I have not hesitated in associating this operculum with the shell, since both are equally abundant in the rock in which they are found, and there is no other shell to which the operculum can be referred. There is no doubt but that many of the species of fossils arbitrarily referred to *Trochus* and *Turbo* will have to be separated as soon as sufficient details of their character shall have been obtained. Notable examples of this may be

seen in such monographs as d'Orbigny's *Pal. Française*. The operculum figured in that work (*Terr. Cret.*, vol. ii. Pl. 186 *bis*, figs. 15–17) evidently belongs to this genus. The author declares himself unable to associate it with its proper shell, and says of the two operculi figured that they are “au moins un confirmation de leur bon classement dans le genre *Turbo*. L'un d'eux est très-remarquable par ses tours très-rapprochés, comme chez les *Trochus* proprement dits.”

In virtue of the general form and the multispiral operculum, I believe this genus to belong near to *Gibbula*, despite the fact of the calcareous nature of the operculum. All of the genera in the *Turbinidæ* approaching it in form have that member markedly paucispiral, and constructed in an entirely different manner.

P. PERUANUS, n. s., Pl. 40, fig. 8.

Shell small, robust, spire moderately elevated, sides regularly sloping; whorls six, flattened on their upper sides; body whorl flattened and sloping above, rounded and bi- or tri-carinate on the margin, and slightly convex below. Surface marked by about six heavily beaded ribs above, the uppermost of which makes the sutural margin; the two on the sides are the largest, and when a third exists it is slightly smaller and placed below the other two; under surface covered with six or seven similar ribs, the last forming a crenulated margin to the umbilicus, which is minute and apparently imperforate. Aperture sloping subquadrate; outer lip simple; inner lip bordered by a flattened pillar lip, the anterior part slightly overlapping the umbilicus.

Locality. From the coal mine of Pariatambo and from the Cerro del Ventanillo. Liassic.

HELCION, Montf.

H. CARBONARIUS, n. s., Pl. 40, fig. 7, 7a.

Shell small, nearly circular, thin; apex subcentral, about a third as high as the diameter of the shell; surface polished and marked by prominent lines of growth.

Locality. With the preceding.

LAMELLIBRANCHIATA.

PANOPÆA, Menard.

P. UNDULATA, n. s., Pl. 40, fig. 9.

Shell sub-elliptic, moderately convex; base nearly straight in the middle; beak prominent; anterior end unknown; posterior gaping, nearly semicircular and with the upper and middle margins reflexed. Surface covered with regular, rounded concentric ribs and subacute interspaces; the ribs larger on the middle

and smaller towards the base; posterior to the beaks are traces of very faint radiating lines, more closely placed than the concentric ribs and barely perceptible except in the interspaces.

Figure. Natural size.

Locality. From the Pueblo of Pion, in the department of the Amazons. Two isolated specimens without associates, considered Cretaceous by Dr. Raimondi.

Remarks. This shell can be distinguished by the rounded gaping posterior end and gently dilated margins, as well as by the marked concentric ornamentation. It is from a hard white limestone unlike any other rock among the upwards of 400 specimens in the collection.

CORBULA, Brug.

C., sp. indet.

Numerous casts of a small equivalve shell, doubtless of this genus, occur among the Cretaceous fossils of the neighborhood of Ollon. Beyond the fact that they are nearly equilateral and equivalve (a slightly greater convexity existing in the right valve and the characteristic biangularity posteriorly), they show no characters. I therefore do not feel warranted in naming the species, since no good diagnostic characters can be given from the material.

C. NUCULOIDES, n. s., Pl. 40, fig. 10.

Shell small, nearly equivalve; beaks very slightly in advance of the middle; anterior end elongately rounded, base regularly curved; posterior cardinal margin concave, the surface flattened; posterior end produced, narrow and rounded. Surface marked by fine lines of growth.

Locality. From the coal mine of Pariatamba. Lias.

Remarks. From the other two species, with which it is associated, this shell can be distinguished by its form, resembling a *Nuculana*, and by its surface, nearly devoid of the heavy lines so characteristic of its genus.

C. PERUANA, n. s., Pl. 40, fig. 11.

Shell small, very inequilateral; beaks placed in advance of the middle; anterior end sloping convexly above and most prominent near the base; base broadly and slightly convex; margin abruptly bent down; posterior side excavated behind the beaks, a concave area running to the posterior end and bounded by a sharp angle; posterior end narrow and produced. Surface marked by small concentric ribs.

Locality. With the preceding.

Remarks. A very characteristic *Corbula*, recognizable from even a fragment both by its outline and markings. It differs from the preceding by its more cunei-

form shape and its ribs. From the following it can be distinguished by the fine ribs, smaller size, and less truncated anterior end. Associated with this is a single specimen, somewhat mutilated, so that the shape is not all retained. It has smaller ribs, and shows faint traces of radiating lines. I believe it to be different, but have not material for describing it. Both are left valves.

C. RAIMONDII, n. s., Pl. 40, fig. 12.

Shell small, robust, cuneiform; beak of right valve large, prominent, and involute; anterior end rounded, truncate, sloping nearly straight and obliquely to the base, where it is narrowly rounded. Base broadly convex; posterior side concave above, the area joining the surface by a regular curve, and not bounded by a ridge as in the preceding species; posterior end narrow and produced. Surface marked by large, rounded concentric ribs.

Locality. With the two preceding species.

Remarks. Easily distinguished by its large, coarse ribs, its prominent beak, the nearly straight sloping anterior end, and by the absence of a ridge running from the beaks to the upper part of the posterior end. The most marked species of the three.

PHOLADOMYA, Sby.

P. AUSTRALIS, n. s., Pl. 40, fig. 14.

Shell small, oblique, very inequilateral, convex; beaks placed close to the anterior end, large, incurved; anterior end narrowly rounded; posterior broad, regularly rounded, and slightly oblique. Surface smooth in advance; seven radiating ribs run from the beaks to the base, their ends occupying almost the entire basal margin; posterior to these the surface is covered with small rounded, concentric ribs, faint traces of which can be seen between the radiations; posterior to the beaks and adjoining the cardinal margin, is a small, narrow, cordate area, slightly concave and bounded by a slight angle.

Figure. Natural size.

Locality. Hacienda of Macanga. Cretaceous.

Remarks. Two suites of specimens, one from near Cajamarca, the other from the province of Huari, have the same size and general form, but show no surface markings.

P. RAIMONDII, n. s., Pl. 40, fig. 15.

Shell very inequilateral; beaks placed about a third of the length from the anterior end, which is broadly and regularly rounded; posterior end narrower than the anterior, and produced; base most prominent directly under the beaks. Sur-

face covered by radiating ribs, which become faint at each end. A slight narrow depression runs parallel with the posterior cardinal margin, bordered by a rounded angle.

Figure. Natural size.

Locality. Between Combayoa and Polloc; Dept. of Cajamarca. From a limestone which, Dr. Raimondi says, "appears to be Jurassic." Two other specimens, referred doubtfully to the same species, are from the hacienda of Macanga, which locality is almost certainly Cretaceous.

P. ZIETENII, Agas., Etud. sur les Myes, p. 54, Pl. 3, f. 13-15.

P. fidicula, Zieten (not Sby.).

P. Zieteni, Bayle & Coquand, Mem. G. Soc. Fr., 2 s., v. 4, p. 26, Pl. 7, f. 8.

Our shell is the same as that figured by the last authors, though I think it is doubtful if this is the same as the European species; it differs in the posterior end and is much more strongly ribbed than Agassiz's figure. It is from the Jurassic(?) rocks in the neighborhood of Ollon.

P., *sp. indet.*

From the Liassic coal mines of Pariatambo there is a single small *Pholodomya*, too much distorted for a very satisfactory determination, and entirely unfitted for description if new, since the outline is destroyed. In style it resembles *P. echinata*, Agas., but has fewer radiating ribs.

HOMOMYA, Agas.

H. INCURVA, n. s., Pl. 40, fig. 13, 13a.

Shell convex, inequilateral; beaks prominent, placed about a third of the length from the anterior end, and strongly incurved; anterior end most prominent just above the middle, above which point to the umbones it is slightly concave, and below which it unites by a broad curve with the broadly and regularly rounded bases; posterior cardinal margin sinuous; posterior end obliquely rounded, subtruncate above, narrowly rounded at its most prominent part in the middle. Surface marked by numerous small rounded concentric ribs.

Figures. Natural size.

Locality. From the neighborhood of Ollon. Cretaceous or Jurassic?

Remarks. Easily distinguished by its short, compact form and its strongly incurved beak. The concentric lines vary in strength in different specimens; in some they are a tenth of an inch across, while in others they diminish to mere lines of growth. I cannot think this indicates two species, because, as is usual in such cases, the undulations are strong on the beaks, and the fine lined forms show

this character on the middle or towards the base. Still, nearly all the specimens being more or less imperfect, I am not certain that there is not also a difference in outline.

H. PONDEROSA, n. s., Pl. 41, fig. 1.

Shell large; beaks prominent, placed about a third of the length from the anterior end; strongly incurved; anterior end sloping nearly straight to the middle; base broadly and pretty regularly rounded, not prominent; posterior end most prominent near the base. Surface (of cast) marked by only very faint concentric lines, and with a broad faint depression towards the base a little posterior to the middle.

Length, 4.5 inches; width, from beak to base, 3.75 in.; width of two valves, 2.5 inches.

Locality. From the elevated table land two leagues from Cajamarca. Considered Cretaceous by Dr. Raimondi.

TELLINA, Linn.

?T. PERUANA, n. s., Pl. 40, fig. 16.

Shell lenticular, broad, sides very flattened; beaks minute, placed about a third of the length from the anterior end; base and anterior end regularly rounded, posterior end somewhat produced, sloping downwards from the beaks and rounded sub-biangular. Surface marked by regular fine concentric striæ.

Figure. Natural size.

Locality. From the coal mine of Pariatambo.

Remarks. Not a rare species; represented by a number of specimens. I have referred it doubtfully to the above genus, because I have been unable to expose the hinge, or even the pallial impression.

CARDIUM, Linn.

Subgen. PROTOCARDIA.

C. (P.) APPRESSUM, n. s., Pl. 40, fig. 17.

Shell thin, not very convex, nearly equilateral, beaks central, anterior end most prominent in the middle, posterior rounded, obliquely truncated; base broadly and evenly rounded; surface marked by small, regular concentric striæ except on the posterior side, which is covered with large radiating ribs, three or four of which, running to the basal angle, are large and more prominent.

Figure. Natural size.

Localities. From the coal mine of Pariatambo, the Cerro of the Ventanillo, and near Ollon.

CRASSATELLA, Lam.

C. CAUDATA, n. s., Pl. 40, fig. 18.

Shell elongate cuneiform, beaks very anterior with the posterior cardinal margin sloping nearly straight to the posterior end, which is narrow and obliquely truncate; anterior end sloping nearly straight from the beaks to near the base, where it is most prominent and rounded. A rounded angle runs from the beaks to the posterior basal angle, behind which the surface is flat or very slightly concave. Surface marked only by coarse lines of growth. Lunule deep and cordate, its margin rounded. The young shells are proportionally much shorter and broader and not so acute posteriorly as the adults.

Figures. Natural size.

Localities. From the black shales of the coal mine of Pariatambo and from the limestones of the Cerro del Ventanillo.

Remarks. A common species, easily recognizable by its elongate, wedge-shaped form. It is perhaps the most abundant fossil in the black shales of the coal mine, associated with *Ammonites carbonarius*. I have never seen the hinge, but have not hesitated in referring it to the above genus, on account of its marked external characters.

C., *sp. indet.*

A very ventricose cast, apparently of this genus, comes from the Cretaceous locality of the hacienda of Macanga. It retains none of the shell, but from its shape and from the impression of the hinge teeth, it seems to be a *Crassatella*.

CARDITA, Brug., Lam.

C. EXOTICA, d'Orb. sp., Pl. 41, f. 1, 2.

Astarte id., d'Orb., Am. Mer., p. 83, Pl. 18, f. 11-12.

id., d'Orb., Foss. Col., p. 48, Pl. 3, f. 11-12.

Shell obliquely elongate subquadrate; beaks about a fourth of the distance from the anterior end; directly under the beaks the anterior end is concave; most prominent a little above the middle, below which point it curves regularly into the base; posterior cardinal margin sloping convexly; posterior end broad and obliquely truncate; surface marked by about twenty-four square ribs, roughened by the crossing of irregular ridges of growth; of these ribs, six or seven, smaller than the others, are on the posterior face of the shell; between the large ribs are broad, concave interspaces; lunule small, deep, cordate; inner margin crenulate.

Figures. Natural size.

Localities. Hill near the Hacienda del Imperial near Cañete, and near the town

of Coniaca, Dept. of Huancavelica. The latter at the height of 3200 metres. D'Orbigny's specimen came from las Palmas, Prov. of Socorro, U. States of Colombia, and was only an internal cast.

Remarks. Dr. Raimondi refers the first to the Cretaceous, and the second to the Jurassic. Generically this shell belongs to that group, or subgenus, separated by Blainville under the subgeneric title of *Cardiocardites* (not *id.* Meek), and to which Dr. Gray subsequently gave the name of *Agaria*. The Carditas have been so divided up into genera and subgenera that, as in this case, the distinction rests almost, if not entirely, on the outline of the shell, and, while the typical form is marked enough, a regularly gradated series of species, recent or fossil, can be produced to show that this is absolutely of no value.

CARDITA (CYCLOCARDIA) CIRCULARIS, n. s., Pl. 41, fig. 3, 3a.

Shell nearly circular, compressed; beaks somewhat anterior, not very prominent; anterior and posterior ends and base forming continuously three-fourths of a nearly perfect circle; cardinal margin sloping convexly; directly under the beaks the anterior end is slightly excavated; lunule very small; surface covered by twenty-seven or twenty-eight regular radiating ribs, each producing a corresponding crenulation on the inner margin.

Figures. Natural size.

Locality. "Snow mountains to the left of the road between Chonta and Quevopalco; Province of Huamalies; at a height of more than 5000 metres." Referred doubtfully to the Cretaceous.

Remarks. Its remarkably circular form will serve to distinguish this shell from all of its congeners. The specimen has a polished appearance, as if it had been long carried in the pocket, and the fine details of the surface are completely worn off.

TRIGONIA, Brug.

T. BRONNII, Agas., Mém. sur les Trigonies, p. 18, Pl. 5, fig. 19.

Lyrodon clavellatum, Bronn, Lethæa, Pl. 20, f. 3.

id., Goldf., Petr. Germ., p. 200, Pl. 136, f. 6 a. b.

Not *T. clavellata*, Sby., Min. Conch., Pl. 87.

A beautiful specimen, agreeing in every detail of outline and ornament with Agassiz's figure and description. Agassiz says the species is peculiar to the Upper Jurassic. Our specimen is from the "immediate vicinity of Jauja; height of 3500 metres."

T. LORENTI, Dana, Wilkes' Exped. Rep., p. 721, Pl. 15, f. 2.

From the Island of San Lorenzo, near Callao. From its type, evidently Juras-

sic. It is closely allied to *T. sinuata*, Park., but differs in having the ribs bent abruptly upwards posteriorly towards the area, and in having them placed closer together on the middle of the shell and more sinuous than in Parkinson's species.

T. sp. indet.

There is a small lot of fossils in a bad state of preservation, marked "neighborhood of Tingo; Prov. of Huari; Dept. of Huaraz; alt. 3500 metres; Jurassic?". Among them is a small *Trigonia*, recognizable principally by the moulds of the hinge. Not enough of the outline is preserved to ascertain the shape, and the impressions of the surface only suffice to show that it was covered with strong transverse ribs. Fortunately the associated fossils are in a more recognizable state, there being among them *Ammonites Ventanillensis, nob.*, *A. carbonarius, nob.*, *Tellina Peruana, nob.*, and *Crassatella caudata, nob.*, all of the present paper, and characteristic of the Liassic beds of the coal mine of Pariatambo and the limestones of the Cerro del Ventanillo. The present rock is a black carbonaceous shale very similar to that of the first of the two mentioned localities, but differs in being a little less calcareous, and in the presence of pyrites which lines the cavities left by the decomposition of several of the shells.

T., sp. indet.

A second species, marked as from the immediate neighborhood of Ollon, and probably Cretaceous, is too imperfect for more than a very doubtful identification. From the number of ribs and general form, I believe it to be the *T. Tocaimana*, Lea, Tr. Amer. Philos. Soc. 1840, p. 256, Pl. 9, f. 8, and which may possibly include *T. Delafosse*, Boyle and Coquand; Mem. Geol. Soc. France, 2 ser., v. 4, Pl. 8, f. 27. This last is represented as differing a little in the costation from Lea's figure; but that was so imperfect a specimen that the matter must be left an open question until better material shall be available.

MYOPHORIA, Bronn.

M. SPIRALIS, n. s., Pl. 41, fig. 4, 4a.

Shell triangular, slightly oblique; beaks in advance of the middle, spirally incurved in advance of and under the umbones; anterior end narrowly and regularly rounded; base sloping slightly upwards behind, where it is nearly straight; most prominent in front; posterior end obliquely truncated; posterior side concave, the concavity bounded by a rounded-angular ridge which runs from the umbone to the posterior-basal angle; surface covered with large, pretty regular lines of growth.

Figures. Natural size.

Locality. From the coal mine of Pariatambo. Liassic.

Remarks. The finest bivalve from this rich and interesting locality. The genus has been usually considered as characteristic of the Trias, all of the species in d'Orbigny's *Prodrome* being placed in his two stages—5 and 6. But here we have it associated with *Crassatella* and with *Ammonites*, one species of which is only doubtfully separated from a known Jurassic form, and with a *Gyrodes*, true somewhat aberrant, but nevertheless belonging to a genus heretofore not known below the Cretaceous.

PTERIA, Scop.

Avicula, Brug.

P. INCONSPICUA, n. s., Pl. 41, fig. 5.

Shell small, flattened, very oblique; beaks terminal; anterior side sloping so that the most prominent part of the base is directly under the angle of the wing; posterior side broadly emarginate above and rounded below. Surface marked by fine lines of growth and a few large faint radiations on the most convex part.

Figure. Twice natural size.

Locality. With the preceding.

BARBATIA, Gray.

B.? RAIMONDII, n. s., Pl. 41, fig. 6.

Shell small, narrow, compressed; beaks one-fourth of the length from the anterior end; umbones low and broad; a broad shallow depression runs from the umbones downwards and backwards, reaching the base about a third of the length of the shell from the anterior end; anterior end produced and submucronate above, sloping inwards below with a broad curve; base broadly and shallowly emarginate just behind a point opposite the umbones, at the termination of the superficial depression; behind this it is broadly but not prominently convex; posterior end rounded, except adjoining the hinge line, where it is slightly emarginate; area long and very narrow; surface marked by numerous fine radiating ribs, a little broken by lines of growth.

Figure. Twice natural size.

Locality. From the coal mine of Pariatambo.

Remarks. Externally this shell resembles d'Orbigny's figure of *Cucullæa Tocaymensis* (Amer. Merid., Pl. 21, figs. 1–3), but differs in having a narrower area, less prominent beaks, and in being of an entirely different form posteriorly.

TRIGONARCA, Con.

T. ORBIGNYANA, n. s., Pl. 41, fig. 7, 7a, 8, 8a.

Shell very large, triangular; beaks placed about a third of the length from the

anterior end, not approximating; anterior end nearly vertical, most prominent near the base; posterior face abruptly truncated; base nearly straight, slightly emarginate and a little the most prominent directly under the beaks; area small, short; internal plate moderate; internal margin entire. Surface unknown; the cast shows traces of numerous rather small radiating ribs.

Figures. Natural size.

Locality. Neighborhood of Ollon. Considered by Dr. Raimondi "Jurassic?", but more probably Cretaceous, both from this and the associated fossils.

Remarks. A large, not very perfect cast, the upper part of the posterior end being broken away, so as to destroy the shape of the point of junction between the area and the posterior margin. Associated with it is a cast of a smaller shell (figs. 8, 8a), an inch across, apparently of the same species, but with a more convex base and flatter sides; the latter difference, however, being one that might be anticipated, from the difference of age. The species cannot be confounded with *Cuc. dilatata*, d'Orb., from the Cretaceous of Bogota, its nearest South American ally, having much higher and more approximating beaks, a straighter base, and less produced posterior end. In *Cucullæa dilatata* the beaks are very wide apart and the lower posterior end much more produced.

T. BREVIS, D'Orb. (sp.), Amer. Merid., p. 89, Pl. 20, f. 2-4.

There is a small shell, one inch in diameter, from the "high table land two leagues from Cajamarca, at a height of more than 3500 metres," which resembles d'Orbigny's figure so closely that I believe it to be the young of that species. D'Orbigny and Raimondi both consider it Cretaceous, and the fossils associated with it seem to confirm the opinion.

T. PERUANA, n. s., Pl. 41, fig. 9, 9a.

Shell trapezoidal, very oblique; beaks anterior, approximated, and incurved; area a little longer than half the length of the shell; posterior end very sloping; base nearly straight. Surface unknown.

Figures. Natural size.

Locality. Neighborhood of Ollon; considered Cretaceous by Dr. Raimondi.

Remarks. A single cast, retaining none of the surface, but showing by its form and by the posterior plates, the generic characters sufficient to place it with certainty, and by its outlines enough specific characters to enable it to be identified. No similar species has been described from the South American secondary rocks.

?ARCA OVALIS, n. s., Pl. 41, fig. 10, 10a.

Shell moderate in size, convex, oblique, very much elongated from beak to base;

base most prominent directly under the posterior end of the hinge line. Area short, narrow, and, at least in part, marked in the usual manner of the *Arcas*. Shell substance thin; surface marked by concentric lines of growth, crossed by some fine obsolete radiations anteriorly; inner margin entire; a very small plate borders the inner edge of the posterior muscular scar.

Figures. Natural size.

Locality. From the hacienda of Macanga, and from the vicinity of Ollon, from a rock which Dr. Raimondi considers Cretaceous.

Remarks. In referring this shell provisionally to *Arca* I have done so in the full conviction that it will be placed in an, as yet, undescribed genus as soon as more material shall have been obtained. It has the form of an oblique *Limopsis*, but I have been able to see about the anterior third of the area, which shows two or three of those incised lines which are characteristic of the *Arcas* and *Cucullæas*. The middle of the area not being visible, I cannot assert that it has not also the *Limopsis* fosset, or at least a rudiment of it. The shell is unusually thin for the family. It wants the marginal crenulation generally seen, and it possesses a rudiment of the internal plate of *Cucullæa*, in the shape of a little ridge bordering only the anterior margin of the posterior muscular scar, and succeeded, in the usual position of the *Cucullæa* plate, by a very faint broadly rounded thickening which runs up into the beak. It will be seen that we have here enough material to characterize this as a new genus, all except the hinge teeth, and the details of the area, the latter of which could, however, be pretty safely inferred.

Another little Arcoid, of which I have only seen one imperfect valve, occurs in the black shale of Pariatambo.

NUCULA, Lam.

N. PERUANA, n. s., Pl. 41, fig. 1.

Shell very small, cuneiform; beaks placed a third of the length from the anterior end, which is rounded; posterior end narrow and rounded; base nearly straight; posterior cardinal margin sloping; surface marked by fine lines of growth.

Locality. Near Tingo; Prov. of Huari; Dept. of Huaraz. Associated with the undetermined *Trigonia* and various species characteristic of the Liassic rocks of Pariatambo; also a single specimen from the latter locality.

Remarks. A cast, showing the outline and characteristic hinge, from the former locality, and another specimen retaining the surface, from the latter. From being almost exactly of the same size, and having about the same degree of convexity as *Corbula nuculoides*, with which it is associated, this shell may be easily confounded

with it; but they can be at once distinguished by the more terminal position of the beaks of this, and its cuneiform shape—while in that, the beaks are nearly central, and the posterior cardinal margin, instead of sloping down a trifle convexly, giving a general wedge shape to the shell in this, is in that markedly concave.

N., *sp. indet.*

A large heavy convex species, with very prominent hinge teeth and subcentral beaks, represented by a single cast from near Ollon.

LIMA, Brug.

From the "limestone of Socabon of the mines of the hill of San Antonio of Morococho, on the road from Lima to Jauja, at a height of 4200 metres," there is a fragment, the impression of perhaps half of the surface of a *Lima* or *Plagiostoma* of the type characteristic of the European Lias. It was, when entire, a little more than two inches long, and marked by numerous fine, equal, radiating ribs.

Also, from the Liassic limestone of the Cerro de la Ventanilla is another *Lima* an inch long. The shell is preserved, but it is attached by its outer surface and only shows the interior of the valve, and without the ears. The surface, as seen through the shell, is marked by rather large radiating ribs, strongest on the posterior half of the shell.

PECTEN, Linn.

P. RAIMONDII, n. s., Pl. 42, fig. 1, 1a.

Shell oblong, flattened, equilateral, slightly inequivalve, closed; surface of both valves covered with strong radiating ribs, about 15 or 16 on each valve. These ribs are surmounted by three ridges, and the intervening grooves carry also one or three small radiating lines; all crossed by strong lines of growth becoming slightly squamose on crossing the ridges; anterior right auricle emarginate.

Figure 1, natural size; *1a*, a magnified cross section of the ribs.

Locality. From the "hill of Potosi, on the road from Lima to Jauja, in the mineral region of Morococho."

Remarks. The unequal convexity of the two valves places this shell in the subgenus *Chlamys*, Bolt., according to H. and A. Adams. It is of the type of *P. Faujasii* and *P. cretosus*, which it resembles in the style of the ribs, while it differs in their details and in general form, being a shorter and rounder shell.

P. ARGENTARIUS, n. s., Pl. 41, fig. 12, 12a.

Shell flattened, base rounded; sides and ears unknown; surface marked by

about 15 or 16 large ribs; angular on top and sloping on the sides; interspaces angular at the bottom; on the sides of the ribs are faint traces of two radiating lines; all crossed by minute, subsquamose lines of growth.

Diameter about 1.3 inch.

Locality. From the "hill of San Antonio, with silver mines, Morococho; altitude 4500 metres," associated with *Rhynchonella Antonii*. No geological age given.

Remarks. I have ventured to name this shell although the outline is almost entirely destroyed, since it cannot fail to be recognized by its slightly convex shell and the peculiar angular ribs and interspaces, a cross section of which forms a zigzag line.

NEITHEA, Drouet.

N. QUINQUECOSTATA, Sowerby, sp.

Pecten id., Sby., Min. Conch., Pl. 56.

Janira id., d'Orb., Pal. Fr., Ters. Cret., p. 632, Pl. 444, f. 1-5.

Neithea id., Gabb, Synopsis Cret. Moll., 1861, p. 148.

A single small specimen, about half grown, retaining both valves. It agrees fully with the European specimens, in all the details of form and ribs. Each large rib has a smaller one on its lateral slope, and the space between each pair of large ribs is occupied by two of slightly smaller size. The specific distinctions in this genus rest on comparatively trivial characters, in the details of surface ornament, and I should have hesitated in referring this shell to Sowerby's species, had I not compared it with authentic specimens from England and France.

Locality. Elevated table-land two leagues from Cajamarca. Cretaceous.

Remarks. We have here an excellent key for establishing a geological horizon, in the presence of a well-known upper greensand species; although it does not follow by any means that the two deposits were absolutely synchronous in their age of deposition. The species may have originated in either of the two regions, and have emigrated, becoming extinct in one before it made its appearance in the other. That this does occur with animals as well as plants is a well-recognized fact; nevertheless, the presence of a species whose geological horizon is established, gives us the means of fixing approximately the age of any new deposit in which it may be discovered.

N. ALATA, Von Buch (sp.).

Pecten alatus, Von Buch, Petr. rec. en Amer., p. 3, Pl. 1, f. 1-4.

P. Dufrenoyi, d'Orb., Am. Mer., p. 106, Pl. 22, f. 5-7.

P. alatus, Bayle & Coq., Mem. Soc. Geol. Fr., vol. 4, p. 14, Pl. 5, f. 1-2.

P. Dufrenoyi, Hup.; Gay's Hist. de Chili, p. 291.

Janira alata, Remond; Pal. de Chili (pamph.), p. 18.

Neithea alata, Gabb, Synopsis Cret. Moll., p. 147.

Three specimens, one from "between Molinas and Paucara;" a second from "a place named Taraino, two leagues below Iscuchaca;" and the third "from the hill of Santa Barbara, where there is a mine of mercury," all in the Dept. of Huancavelica. To the last no geological age is assigned, but Dr. Raimondi refers the first two doubtfully to the Jurassic. Bayle and Coquand referred the shell to the Lias, while d'Orbigny in the Prodrôme places it in the Neocomien, in which opinion I followed him in my "Synopsis." Huppé also considers it Lias.

N., sp. indet.

A rolled specimen of the deep valve of an undescribed species, characterized by about 25 nearly uniform large ribs and no apparent intermediate sculpture. It is nearest to *N. Texana*, Roem. (sp.), but that has but 15–17 ribs. It is from the "town of Bagua, on the left bank of the river Utcubamba, Dept. of Chachapoyas."* The shell is too imperfect to describe, but is important as fixing the Cretaceous age of the rocks from which it is derived.

PLICATULA, Lam.

P. TORTA, n. s., Pl. 42, fig. 5.

Shell long, subtriangular, slightly oblique, inequivalve; lower valve slightly convex, upper valve flat; right side nearly straight, left side and base broadly rounded; surface marked by large, coarse squamose lines of growth, crossed by small radiating ribs, which are interrupted by the concentric lines and present a fimbriated appearance.

Figure. Natural size.

Locality. Quebrada of Colpamayo, near Chota, Dept. of Cajamarca. Cretaceous.

ANOMIA, Linn.

A. PERUANA, n. s., Pl. 42, fig. 6.

Shell variable in shape; circular to irregularly elliptical; beaks low, marked, and submarginal; surface marked by irregular lines of growth and concentric undulations.

Measurements. Average diameter, about 0.8 in. One specimen, one inch long by 0.75 wide.

Locality. "Quebrada del Alfalfar, a quarter of a league south of Chachapoyas," on the surface of a distorted cast of a large shell, apparently *Cucullæa Orbignyana*. Cretaceous.

Remarks. The surface of the cast is covered by a group of these little shells,

* So says the label, while the catalogue accompanying places it in the "Department of the Amazons."

which had evidently attached themselves to the inner face of the larger one after the death of its occupant. The lower valves are lost in all but one example, and there only traces of it remain.

PLACUNANOMIA, Brod.

P. (PARANOMIA?) LIMA, n. s., Pl. 42, fig. 7.

Shell flat, equivalve, subtriangular; upper margins irregularly sloping; base broadly rounded; surface covered with rough subsquamose lines of growth, crossed by small radiating ribs which, at short intervals, rise into little spines like the teeth of a rasp, or better, like the low spines of some species of *Spondylus*.

Measurements. Length of largest specimen, 2.0 in.; width, 1.7 in.

Localities. From the neighborhood of Ollon; the Hacienda of Macango, and Quebraba of Colpamayo, near Chota, Dept. of Cajamarca. Cretaceous.

Remarks. None of the specimens show the hinge or the internal structure, so that we do not know whether or not it has the internal plate of Conrad's subgenus. It resembles the typical species of that group in the sculpture of the surface, but both valves seem to be equally convex and equally strongly marked with the scabrous ribs.

OSTREA, Linn.

O. CALLACTA, Con., Pl. 42, fig. 2, 2a.

id., Con., Proc. Acad. Nat. Sciences, 1875, p. 139, Pl. 22, f. 1.

O., *sp. indet.*, Dana, Wilkes' Exped. Rep., Pl. 15, f. 7.

Shell large, oval, nearly equilateral; beaks central, small. Lower valve with one large median ridge, from the lower part of which branches another on each side, the terminations of the three occupying the entire basal margin; a large curved rib runs from the beaks, describing a quarter of a circle, and terminating on the middle of the side; above this on each side are two smaller ribs, rapidly diminishing in size. Each rib on the lower valve corresponds to an interspace on the upper valve, and each interspace of the lower to a rib on the upper. Entire surface covered by rough lines of growth. Area broad, flat; ligament pit very broad and shallow, oblique; margin squamose, not crenulated; muscular impression moderate in size.

Measurements. Diameter from beak to base, 4.5 in.; from side to side, 4.0 in.

Locality. From the Cretaceous at the Hacienda of Macanga, Prov. of Pataz. Mr. Conrad's type came from "the Pampa del Sacramento, Eastern Peru," and he conjectured it to belong to the "Pebas Group" of brackish water Tertiary, first made known by me in 1868.

Remarks. A fine large species, at once recognizable by its outline and its few, large, symmetrically arranged ribs. It was figured without a name in the report of the Wilkes' Exploring Expedition.

O. LARVIFORMIS, n. s., Pl. 42, fig. 3.

Shell small, very inequilateral, oblique, arcuate, nearly equivalve; beaks terminal; posterior side and base forming together a semicircle; anterior side produced, somewhat excavated above; surface marked by about seven large radiating ribs, alternating on the opposite valves; the posterior two or three dividing into two near the margin. All crossed by rough lines of growth. Interior unknown.

Figure. Twice natural size.

Locality. "Hill of three crosses, between Aguamiro and Huallacan, Prov. of Huamalias; height more than 4000 metres." Considered Cretaceous by Dr. Raimondi.

Remarks. A pretty little oyster of the type of *O. larva*, but much shorter, broader, and heavier than that species. From a notch near the beak, it seems to have grown attached to a twig, in the manner of the recent mangrove oysters.

EXOGYRA, Say.

E. POLYGONA, Von Buch, Petr. rec. en Amer., p. 5, Pl. 2, f. 18-19.

Two fine specimens of this strongly characterized species from between Combayo and Polloc; Dept. of Cajamarca. Dr. Raimondi says "calcareous rocks which seem to belong to the Jurassic formation." D'Orbigny refers the species to the Neocomien. Should the small *Exogyra* found with *Ammonites Raimondianus* prove to be this species, it may have to be placed higher in the Cretaceous. See remarks on *E. plicata*.

E., *sp. indet.*, Pl. 8, fig. 4, 4a.

A small shell from the same locality as the preceding, showing the exsert spiral beak characteristic of the genus, but too imperfect to describe. It seems to be somewhat of the type of *E. arietina*, Roem., of the Texas Cretaceous, but not so developed in the beak. The surface is very convex, especially in the middle, and seems to have been smooth. Its entire length is barely three-fourths of an inch.

E. PLICATA, Lam.

For synonymy see Palæontology of California, vol. 2, p. 275.

Two specimens from the same locality as the other two species, and which seem to belong to this well-known form. Their surfaces are somewhat obscured by the matrix, and one at least is marked by unusually small ribs. This, however, is not a valid specific distinction in this genus.

E. PARASITICA, Gabb? Pl. 42, fig. 8, 8a.

E. parasitica, Gabb, Pal. California, vol. 1, p. 205, Pl. 26, f. 192, and Pl. 31, f. 273.

Attached to the large *Cucullæa Orbignyana* is a group of little parasitic *Exogyras*, all of the same size, and one of which is figured, showing the upper valve and a side view of the lower. In an object possessing so few specific characters I can find none by which to separate this shell from that described by me under the above name from the Cretaceous formation of California.

GRYPHÆA, Lam.

G. RIVOTII, Bayle and Coquand (sp.).

Ostrea, *id.*, B. & C., Mem. Geol. Soc. Fr., 2 s., v. 4, p. 24, Pl. 1, fig. 7, 8.

O. cymbium, B. & C., *pars.* (not Desh.), *loc. cit.*, Pl. 5, f. 6-7.

From the silver mines of Huantajaya. From the figures they give, I strongly suspect that these authors have also included other specimens (Pl. 4, f. 1, 2, 4) in "*O. cymbium*" that belong to this species.

GRYPHÆA, Lam.

G., *sp.*? Pl. 41, fig. 13, 13a.

Five specimens, all lower valves, exactly alike, from the Cretaceous of the Hacienda of Macango, Prov. of Patatz, look like miniature examples of *G. vesicularis*. In all details of shape and proportions they agree so exactly that, were it not for the marked difference in size I should not hesitate in referring them to that species. But their uniformity of size seems to point to a good specific difference. I therefore propose the provisional name of *G. vesiculoides*, in case they may eventually prove distinct.

Figures. Natural size.

TEREBRATULA, Brug.*

T. RAIMONDIANA, n. s., Pl. 42, fig. 9, 9a, 9b.

Shell ovate; beak prominent, overhanging; foramen large, sides most prominent in the middle, below sloping nearly straight to the base, which is subtruncate; small valve with two large plications, which begin about the middle and run to the outer sides of the basal margin; between and on each side of these is a broad, shallow depression, making the edges of the shell sinuous and emarginating the base of the larger valve. On the large valve there is barely a trace of the plications seen on the smaller valve, the surface being almost evenly convex. Surface marked by lines of growth and a few very obscure radiating lines.

* I have attributed the genus *Terebratula* to Brugiere on the ground that, although the name was used for nearly a century before, by various pre-Linnæan authors, Brugiere was the first to restrict it to near its present limits. Even Linnæus confounded it with *Anomia*, and the author of the *Encyclopedie Méthodique* was the first to make a truly scientific use of the name.

Figures. Natural size.

Locality. "A little distance from the town of Ollon."

Remarks. This species is broader and more rounded on the sides than *T. ornithocephala*, Sowerby, the lateral margins of the valves are more sinuous, and it is flatter towards the base, and the plications on the smaller valve are wanting in that species. In the absence of plications on the dorsal valve, it differs from all the other species described from South America.

RHYNCHONELLA, Fisch.

R. ANTONII, n. s., Pl. 42, fig. 10, 10a.

Shell triangular, widest about a third of its length from the base, which is rounded; sides sloping nearly straight from the beak at an angle of about 70° from each other; beak narrow, elevated; area large. Large valve bearing a broad shallow sinus, ending in a correspondingly broad, short tongue which encroaches on the small valve. Smaller or ventral valve regularly convex on the surface except close to the base, where the side of one rib is carried down to fit the side of the tongue of the opposite valve. Surface ornamented by about eighteen radiating ribs, of which usually six are in the groove of the dorsal valve and seven corresponding with those on the ventral; in one example there are eight on the dorsal and nine on the ventral valves in the middle.

Figures. Slightly magnified.

Localities. Three specimens marked "Cerro de San Antonio, with mines of silver." This locality is also given for *Pecten argentarius*, but the rock is different lithologically. Another specimen is marked "Quebrada de Colpamayo, near Chota," the locality of *Placunanomia lima*. This agrees lithologically with the other specimens of the same species, but also differs from the other fossils of the locality. Still another specimen in a coarse red sandstone is marked "Cerro de Vivuco, a league and a half from Ollon." Thus two of the three lots are said to come from Cretaceous localities or neighborhoods, but all three differ in the character of the rock from the other fossils. We have, therefore, no reliable clue to the geological age of the species.

ECHINODERMATA.

ECHINUS, Linn.

E. BOLIVARII, d'Orb., Amer. Merid., p. 88, Pl. 21, fig. 11-13.

From the "Hacienda of Uchupata; Prov. of Huari. Cretaceous."

E.? sp. indet.

Another shell, resembling this genus, but with all the finer details destroyed by crystals of carbonate of lime, which has completely replaced the shell, leaving only the external form and the coarser details of the ambulacra. It is from the Liassic locality of the Cerro del Ventanillo.

BOTRIOPYGUS, d'Orb.

B. ELEVATUS, n. s., Pl. 43, fig. 1, 1a.

Shell very rounded subpentagonal, slightly narrowed in front and produced in the middle behind; broadly convex above, concave below; details of ornament of upper surface unknown; lower surface closely studded with small tubercles.

Figures. Natural size.

Locality. From the Cretaceous table, two leagues from Cajamarca.

B. COMPRESSUS, n. s., Pl. 43, fig. 2, 2a.

Shell broadly elliptical, ends equal; upper surface very broadly convex; under, slightly concave; details of surface ornament unknown.

Figures. Natural size.

Locality. Near Calca, a few leagues south of Chachapoyas. Cretaceous.

Remarks. This species is larger than the preceding, and differs in being flatter, broader, and regularly elliptical. In that, the anterior end is narrower than the posterior, and the region of the anal opening is prominent; whereas in this, both ends are of the same shape and width.

DISCOIDEA, Gray.

D. NUMISMALIS, n. s., Pl. 43, fig. 3, 3a, 3b.

Shell faintly pentagonal, very depressed, apex slightly elevated, surface sloping straight, or a little concavely and then convexly to the margin; under surface concave; anal opening large, elongate. Surface marked by numerous small, regularly placed tubercles, scattered uniformly; larger and more scattered on the under side.

Figures. Natural size.

Locality. "Cattle estate of Yauca, at the foot of the perpetual snow, one league and a half from the town of Queropalca, Prov. of Huamalies; height of 4000 metres." Marked "Cretaceous?"

Associated with this is a smaller specimen of the same genus, but apparently another species. The surface has been rubbed smooth and the centre bored so as to enable it to be used as a bead. It is marked 1000 metres higher, same vicinity.

Two others, agreeing with it in character occur, but both are so imperfect on the surface that I have not ventured to describe them. The first is from the elevated table-land, two leagues from Cajamarca; the other from the town of Pion, Prov. of the Amazons. They are certainly Cretaceous.

ENNALASTER, d'Orb.

E. PERUANUS, n. s., Pl. 43, fig. 4, 4a, 4b, 4c.

Shell rounded subpentagonal; anterior end rounded, emarginate; posterior truncate; sides most prominent in advance of the middle; top convex, highest posteriorly; mouth small, rounded; anus rounded-triangular, with the apex below. Upper surface with tubercles sparsely scattered, some smaller ones bordering the anterior groove; below, a triangular space between the mouth and posterior end is closely studded with tubercles, while the remainder of the surface carries but few.

Figures. Natural size.

Locality. From the Cretaceous table, two leagues from Cajamarca, and near Ollon.

Remarks. Closely allied to *E. Texanus*, Roem. sp. (*Toxaster*), but is less markedly pentagonal, more narrowed behind, and differs in the shape of both the apertures.

PERIASTER, d'Orb.

P. AUSTRALIS, n. s., Pl. 43, fig. 5, a, b, c.

Shell ovate-pentagonal, narrowed and truncated behind; rounded and emarginate in front; ambulacra deeply impressed, the posterior pair very much shorter than the others; the inter-ambulacral spaces angulated in the middle near their apices; upper surface high posteriorly, sloping downwards in advance; mouth subreniform, transverse; anus elliptical, greatest diameter vertical. Surface closely covered with small tubercles; on the under side is a triangular space with its apex towards the mouth, bordered by a broad naked strip.

Figures. Natural size.

Localities. From the hills of the District of Huancaspata, Prov. of Pataz, and from the Hacienda of Uchupata, Prov. of Huari; also, the Hacienda of Macanga, the neighborhood of the town of Huallanca, Prov. of Huamalies and near the town of Bagua, Dept. of Chachapoyas. Cretaceous.

Remarks. This species differs from the Texan Cretaceous *P. Texanus*, Roem. sp. (*Hemiaster*) in having a less pentagonal outline, being broader and much higher posteriorly, with the apex placed further back, and in having the anal groove less pronounced. It also differs somewhat in the shape and position of both apertures.

PART III. CARBONIFEROUS FOSSILS.

The following little lot is, with the exception of a single species, from the "Island of Titicaca in the lake of the same name, at an altitude of 4000 metres." The geological age is fixed at once by the presence of the universally distributed *Fusulina cylindrica*. The deposit consists of a reddish-brown and gray limestone, and the genus *Productus* is well represented both in number of species and specimens.

TEREBRATULA, Brug.

T. TITICACENSIS, n. s., Pl. 42, fig. 11, 11a.

Shell small, convex, subpentagonal; beaks high, sides concavely sloping; area small; surface covered only with fine lines of growth. Adult shell, large valve with a deep median sinus, ending in a long, tongue-like projection of the base, and bounded by two large rounded ridges; corresponding with this sinus, there is one equally large ridge in the small valve. The presence of this sinus and ridge cause the lateral margins of the valves to be strongly sinuous. In the young shell the margins are straight and the sinus is wanting.

Figures. Natural size.

Remarks. Allied to *T. Peruvianus*, d'Orb., but larger and more regularly slender. That species is referred by the author to the Devonian.

RHYNCHONELLA, Fisch.

R. ANDII, d'Orb. (sp.).

Terebratula, *id.*, d'Orb., Amer. Merid. 45, Pl. 3, f. 14-15.

Atrypa, *id.*, d'Orb., Prod. Pal. Strat., v. 1, f. 147.

PRODUCTUS, Sby.

P. CANCRINI, Verneuil, Geol. Russ., p. 273., Pl. 16, f. 8; Pl. 18, f. 7.

P. spinosus, Kutorga, Vert. der Min. Ges. St. Pet., 1842, p. 18, Pl. 5, f. 2, *not id.* Sby.

P. Villiersii, d'Orb., Am. Mer., p. 53, Pl. 4, f. 12-13.

P. BOLIVIENSIS, d'Orb., Amer. Merid., p. 52, Pl. 4, f. 5-9.

I refer a single rather imperfect specimen to this species, since it has all of the characters assigned by the author so far as can be made out.

P. PAPILIO, n. s., Pl. 42, fig. 12, 12a.

Shell subquadrate; beak small; cardinal line produced into two expanded submucronate points; sides emarginate, narrowing below, base deeply emarginate; surface of large valve with a deep median groove and two shallower radiating

depressions running to the sides; the basal two-fifths of the surface is bent down at a right angle; entire surface marked by small closely-placed ribs, between which are small punctures; these ribs are crossed by small concentric undulations, taking the direction of the lines of growth. Smaller valve unknown.

Figure. Natural size.

Remarks. Allied to *P. Boliviensis* and *P. Andii*, d'Orb., in the expanded hinge line, but differs from both in the beak being very small, instead of being large and incurved. A marked character, by which it can be distinguished from all the other known species of South America, is the sudden manner in which the basal portion of the surface is bent down at a right angle.

P. RETICULATUS, n. s., Pl. 42, fig. 13, 13a.

Shell large, subquadrate; hinge line not longer than the greatest width of the shell; sides and base broadly rounded; base but very faintly emarginated. Lower valve with a shallow median groove, bent down to nearly a right angle, but not abruptly; beak small; upper valve nearly flat, slightly concave towards the margin and slightly grooved in the middle of the basal portion. Surface marked by numerous small ribs, crossed by concentric ridges of about the same size, producing a cancellated appearance.

Figures. Natural size.

Remarks. Allied to *P. Inca*, d'Orb., but less coarsely striate, more angulated in cross section of the lower valve, from beak to base; the beak is very much smaller, and it wants entirely the traces of spines on the surface seen in that species.

P., sp. indet.

A small species, barely half an inch wide, too imperfect for description, from the "Heights of Cullachaca, three leagues from Huanta."

POLYZOA.

RETEPORA.

R. FLEXUOSA, d'Orb., Amer. Merid., p. 57, Pl. 6, fig. 6-8.

CRINOIDEA.

Two or three masses containing stems of crinoids, one of which is four inches long, half an inch in diameter, and cylindrical.

FORAMENIFERA.

FUSULINA, Fisch.

F. CYLINDRICA, Fisch., Oryct. Gouv. Mosc., p. 126, Pl. 18, f. 1-5.

PART IV. BIBLIOGRAPHY OF S. AMERICAN PALÆONTOLOGY.

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1842. D'Orbigny, Alcide; *Voyage dans l'Amérique Meridionale*, vol. 4. Palæontology, Tertiary to Palæozoic.
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PART V.—SYNOPSIS OF SOUTH AMERICAN PALÆONTOLOGY.

PALÆOZOIC.

ARTICULATA.

DALMANIA PAITUNA, Hartt and Rath., Ann. N. Y. Lyc. 1875, p. 111.	Devonian; Brazil.
CALYMENE VERNEUILII, d'Orb., Am. Mer., p. 31, Pl. 1, f. 4-5.	Silurian; Bolivia.
C. MACROPHTHALMA, Brogn., Hist. des Crust., Pl. 15, f. 1-5.	
Id. d'Orb., Am. Mer., p. 31, Pl. 1, f. 6-7.	Sil.; Bolivia.
HOMALONOTUS OIARA, Hartt and Rath., An. N. Y. Lyc., 1875, p. 114.	Dev.; Braz.
ASAPHUS BOLIVIENSIS, d'Orb., Am. Mer., p. 32, Pl. 1, f. 8-9.	Sil.; Bol.
CRUZIANA, d'Orb. (<i>Bilobites</i> , Cord., not DeKay).	
C. RUGOSA, d'Orb., Am. Mer., p. 30, Pl. 1, f. 1.	
<i>Bilobites</i> on plate.	Sil.; Bol.
C. FURCIFERA, d'Orb., Am. Mer., p. 30, Pl. 1, f. 2-3.	
<i>Bilobites</i> on plate.	Sil.; Bol.

MOLLUSCA.

CEPHALOPODA.

TENTACULITES ELDREDGIANUS, H. and R., Ann. N. Y. Lyc., 1875, p. 126.	Dev.; Brazil.
BELLEROPHON MORGANIANUS, H. and R., Ann. N. Y. Lyc., 1875, p. 117.	Dev.; Brazil.
B. COUTINHOANUS, H. and R., Ann. N. Y. Lyc., 1875, p. 117.	Dev.; Brazil.
B. GILLETIANUS, H. and R., Am. N. Y. Lyc., 1875, p. 118.	Dev.; Brazil.

GASTEROPODA.

NATICA BUCCINOIDES, d'Orb., Am. Mer., p. 43, Pl. 3, f. 8-9.	Carb.; Bol.
N. ANTISIENSIS, d'Orb., <i>loc. cit.</i> , p. 43, Pl. 3, f. 10.	Carb.; Bol.

Neither of the above species belong to the genus to which the author referred them, nor to any other living genus. The information given us in the work is too imperfect to enable one to decide satisfactorily where they should be placed. If the restored outline of the first is correct, it does not belong even to this family.

SOLARIUM ANTIQUM, d'Orb., Am. Mer., p. 42, Pl. 3, f. 1-3.
S. PERVERSUM, d'Orb., <i>loc. cit.</i> , p. 43, Pl. 3, f. 5-7.

Both of these are from the Carboniferous of Bolivia and seem to be antique forms, possibly identical with, or at least closely allied to, the modern genus *Architectonica*, from which they differ in the absence of the characteristic sculpture.

PLEUROTOMARIA ANGULOSA, d'Orb., <i>loc. cit.</i> , p. 43, Pl. 3, f. 4.	Carb.; Bol.
P. ROCHANA, H. and R., Ann. N. Y. Lyc., 1875, p. 115.	Dev.; Braz.
PLATYCERAS SYMMETRICUM, Hall, 15 Ann. Rep. N. York State Cabinet, 1862, p. 34.	
<i>Id.</i> H. and R., Ann. N. Y. Lyc., 1875, p. 116.	Dev.; Brazil.

LAMELLIBRANCHIATA.

GRAMMYSIA (<i>Pholadella</i> ?) PARALLELA, Hall.	
<i>Id.</i> H. & R., A. N. Y. Lyc., 1875, p. 120.	Dev.; Brazil.
EDMONDIA PONDIANA, H. & R., A. N. Y. Lyc., 1875, p. 121.	Dev.; Brazil.
E. SYLVANA, H. & R., A. N. Y. Lyc., 1875, p. 122.	Dev.; Brazil.
MEGALODON ANTIQUA, d'Orb., Prod., v. 1, p. 130.	
<i>Trigonia antiqua</i> , d'Orb., Am. Mer., p. 44, Pl. 3, f. 12-13.	Carb.; Bol.
MODIOMORPHA PIMENTANA, H. & R., A. N. Y. Lyc., 1875, p. 123.	Dev.; Brazil.
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P.? SIMPLEX, H. & R., <i>loc. cit.</i> , p. 125.	Dev.; Brazil.
NUCULITES NYSSA, Hall; H. & R., <i>loc. cit.</i> , p. 119.	Dev.; Brazil.
N. ERERENSIS, H. & R., <i>loc. cit.</i> , p. 120.	Dev.; Brazil.
PECTEN PAREDESI, d'Orb., Am. Mer., p. 44, Pl. 3, f. 11.	Carb.; Bol.

BRACHIOPODA.

TEREBRATULA TITICACAENSIS, Gabb, n. s.	Carb.; Peru.
SPIRIFER BOLIVIENSIS, d'Orb., Am. Mer., p. 37, Pl. 2, f. 8-9.	Dev.; Bol.

- S. INCRASSATUS*, Eichw., Russ., p. 276, Pl. 4, f. 12.
S. PENTLANDI, d'Orb., Am. Mer., p. 48, Pl. 5, f. 15. Carb.; Bol.
S. QUICHUA, d'Orb., *loc. cit.*, p. 37, Pl. 2, f. 21. Dev.; Bol.
S. ROISSYI, Lev., Mem. G. Soc. Fr., 1835, p. 39, Pl. 2, f. 18.
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S. Roissyi, d'Orb., *loc. cit.*, p. 46. Carb.; Bol.
S. STRIATUS, Sby., M. Con., p. 125, Pl. 270.
S. condor, d'Orb., A. Mer., p. 46, Pl. 5, f. 11-14. Carb.; Bol.
ATRYPA ANDII, d'Orb., Prod. Pal., v. 1, p. 147.
Terebratula id., d'Orb., Am. Mer., p. 45, Pl. 3, f. 14-15. Carb.; Bol., Peru.
A. GAUDRYI, d'Orb., Prod. v. 1, p. 147.
Terebratula id., d'Orb., A. Mer., p. 45, Pl. 3, f. 16. Carb.; Bol.
A. ANTISIENSIS, d'Orb., Prod., v. 1, p. 95.
Terebratula id., d'Orb. A. Mer., p. 36, Pl. 2, f. 26-28. Dev.; Bol.
A. PERUVIANA, d'Orb., Prod., v. 1, p. 95.
Terebratula id., d'Orb., A. Mer., p. 36, Pl. 2, f. 22-25. Dev.; Bol.
ORTHIS HUMBOLDTII, d'Orb., A. Mer., p. 27, Pl. 11, f. 16-20.
Spirifer, on plate. Sil.; Bol.
O. CORA, d'Orb., A. Mer., p. 48, Pl. 3, f. 21-23. Carb.; Bol.
O. BUCHII, d'Orb., *loc. cit.*, p. 49. Carb.; Bol.
O. INCA, d'Orb., *loc. cit.*, p. 38, Pl. 2, f. 10-12. Dev.; Bol.
O. PECTINATA, d'Orb., *loc. cit.*, p. 39, Pl. 2, f. 13-15. Dev.; Bol.
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PRODUCTUS ANDII, d'Orb., *loc. cit.*, p. 54, Pl. 5, f. 1-3. Carb.; Bol.
P. BOLIVIENSIS, d'Orb., *loc. cit.*, p. 52, Pl. 4, f. 5-9.
P. Bolivienensis & Gaudryi, on plate. Carb., Bol. & Peru.
P. CANCRINI, Vern., Geol. Russ., p. 273, Pl. 16, f. 8, and Pl. 18, f. 7.
P. spinosus, Kutonga, Verh. der Min. Ges., St. Pet. (1842), p. 18, Pl. 5, f. 2.
Not P. spinosus, Sby.
P. Villiersii, d'Orb., A. Mer., p. 53, Pl. 4, f. 12-13.
P. Cancrini, Gabb, present paper. Carb.; Bol., Peru.
P. CAPACII, d'Orb., A. Mer., p. 50, Pl. 3, f. 24-26. Carb.; Bol.
P. CORA, d'Orb., *loc. cit.*, p. 55, Pl. 5, f. 8-9. Carb.; Bol.
P. HUMBOLDTII, d'Orb., *loc. cit.*, p. 54, Pl. 5, f. 4-7. Carb.; Bol.
P. INCA, d'Orb., *loc. cit.*, p. 51, Pl. 4, f. 1-3. Carb.; Bol.
P. PAPILIO, Gabb, new sp. Carb.; Peru.
P. PERUVIANUS, d'Orb., Am. Mer., p. 52, Pl. 4, f. 4. Carb.; Bol.
P. RETICULATUS, Gabb, new sp. Carb.; Peru.
LEPTÆNA VARIOLATA, d'Orb., Am. Mer., p. 49, Pl. 4, f. 10-11.
Productus id., d'Orb., on plate.
LINGULA SUBMARGINATA, d'Orb., Prod. Pal., v. 1, p. 14.
L. marginata, d'Orb., Am. Mer., p. 28, Pl. 2, f. 5. Sil.; Bol.
L. MUNSTERI, d'Orb., *loc. cit.*, p. 29, Pl. 2, f. 6. Sil.; Bol.
L. DUBIA, d'Orb., *loc. cit.*, p. 29, Pl. 2, f. 7. Sil.; Bol.

POLYZOA AS RADIATA.

RETEPORA FLEXUOSA, d'Orb., Am. Mer., p. 57, Pl. 6, f. 6-8.

Id. G., present paper.

Carb.; Bol., Peru.

RADIATA.

CYATHAXONIA STRIATA, d'Orb., Prod. Pal., v. 1, 158.

Turbinolia striata, d'Orb., Am. Mer., p. 56, Pl. 6, f. 1-5.

Carb.; Bol.

CERIPORA RAMOSA, d'Orb., *loc. cit.*, p. 56, Pl. 6, f. 9-10.

Carb.; Bol.

GRAPTOLITHUS FOLIACEUS, Murch., Sil. Syst., Pl. 26, f. 3.

G. Murchisonii, Beck, Murch., Sil. Syst., Pl. 26, f. 4.*G. dentatus*, d'Orb., Am. Mer., p. 32, Pl. 2, f. 1.

Sil.; Bol.

FORAMENIFERA.

FUSULINA CYLINDRICA, Fisch., Oryct. Gouv. Mosc., p. 126, Pl. 18, f. 1-8.

Id. G., present paper.

Carb.; Peru.

MESOZOIC.

CRUSTACEA.

CIRRIPEDIA.

Pinna minuta, Gabb, Proc. Phila. A. N. S., 1860, p. 198, Pl. 3, f. 10, from the Cretaceous of Chile, is apparently the carinal plate of a *Scalpellum*, and since no species of this genus has been described from this region, it will have to retain the specific name and be called *S. minutum*. This is an unfortunate name, since the species is of average size, but is another illustration of the bad results which arise from even well-intentioned character names, and not less so of the regrets with which more mature students sometimes have to look back on their juvenile efforts.

MOLLUSCA.

CEPHALAPODA.

BELEMNITES CHILENSIS, Con., U. S. Naval Astron. Exped., p. 284.

Id. Philippi, Viaje al Desierto Atacama, p. 143, Pl. 1, f. 4. Jurassic? Chile.

B. GIGANTEUS, Schlot., 1803; Taschenbuch, p. 284.

Id. Huppé, Gay's Chile, p. 25.

Ool.; Chile.

For synonymy see d'Orb., Pal. Fr., Terr. Jus., p. 112.

HELICERUS FUEGIENSIS, Dana, Wilkes' Exped., p. 720, Pl. 15, f. 1.

Cret.; Pat.

NAUTILUS CHILENSIS, Huppé, Gay's Chile, p. 30.

Jur.; Chile.

N. DEKAYI, Morton, Syn. Cret., p. 33, Pl. 8, f. 4.

N. perlatus, Mort., *id.*, p. 33, 13, f. 4.*N. Orbignyanus*, Forbes, Darwin's S. A., p. 265, Pl. 5, f. 1.*N. lævigatus*, d'Orb., Voy. Astrol. and Zélée, Pl. 6, f. 1-2.*N. Valenciennii*, Hup., Gay's Chile, p. 28, Pl. 1, f. 1.

Cret.; Chile

N. INDICUS, d'Orb., Prod., vol. 2, p. 211.

N. Sowerbyanus, d'Orb., Voy. Ast. and Zel., Pl. 4, f. 1-2.

Cret.; Chile.

N. SEMISTRIATUS, d'Orb., Pal. Fr., Ter. Jur., Pl. 26, f. 1-3.

- N. Domeykus*, d'Orb., A. Mer., p. 103, Pl. 22, f. 1-2.
N. semistriatus, Hup., Gay's Chile, p. 29.
N. semistriatus, Bayle & Coquand, M. G. Soc. Fr., 2 s., v. 5, p. 9, Pl. 1, fig. 4. Jurassic; Chile.
N. STRIATUS, Sby., M. Con., p. 183, Pl. 182.
 Id. B. & Coq., M. G. Fr., 2 s., v. 5, p. 8, Pl. 2, f. 6.
 Id. Hup., Gay's Chile, p. 30. Lias.; Chile.
N. TENUI-PLANATUS, Dana, Wilkes' Exped., p. 721, Pl. 15, f. 4. Jur.; Peru.
BACULITES ANCEPS, Lam., A. S. V., v. 7, p. 648.
 Id. d'Orb., Astr. and Zel., Pl. 4, f. 8-12.
 Id. Hup., Gay, p. 41. Cret.; Chile, Col.
B. Granatensis, Karst., Geog. Verh. N. Gren., p. 105, Pl. 2, f. 1.
B. Maldonadi, K., *loc. cit.*, p. 105, Pl. 2, f. 2.
B. LYELLI, d'Orb., Ast. & Zel., Pl. 4, f. 3-7.
B. vagina, Fbs., Darwin's S. A., Pl. 5, f. 3.
Not id., Fbs., Tr. G. Soc. Lond. Cret.; Chile.
B. VAGINA, Fbs., Tr. G. Soc. Lond., v. 7, p. 114, Pl. 10, f. 4.
Not id., Fbs., Darwin's Geol. Obs. S. A.
B. ornata, d'Orb. Astr. & Zel., Pl. 6, f. 3-6. Cret.; Chile.
PTYCHOCERAS HUMBOLDTIANUS, Karst., Geog. Verh. N. Gren., p. 101, Pl. 1, f. 1. Cret.; Col.
HAMULINA DEGENHARDTII, (V. Buch sp.), d'Orb., Prod., v. 2, p. 102.
Hamites id., Von Buch, Petr. Rec. par Humb., p. 17, figs. 23-25.
 Id. Forbes, Quart. Jour. Geol. Soc., v. 1, p. 175. Cret.; Colombia.
 Id. Karst., Geog. Verh. N. Gren., p. 102.
HAMITES HUMBOLDTIANA, Lea sp.
Orthoceras id., Lea, Tr. A. P. S., 2 s., v. 7, p. 253, Pl. 8, f. 1.
Hamites d'Orbignyana, Forbes, Quart. J. G. Soc., v. 1, p. 175.
 On comparing Mr. Lea's original specimen with Forbes' paper, it becomes clear that his determination of the *Ancyloceras* as being the same as Lea's species is incorrect. The *Ancyloceras* has tubercles on the septate portion of the shell, and on the body chamber the ribs are irregularly placed. This part is also not perfectly straight. Forbes' description and figure of his *Hamites* correspond exactly with Mr. Lea's fragment, now before me. I have therefore revised his determination.
CRIOCERAS DUVALII, Lev., Mem. G. Soc. Fr., v. 2, p. 313, Pl. 22, f. 1.
 Id. Bayle & Coq., M. G. S. F., 2 s., v. 4, p. 34, Pl. 3, f. 1-4.
 Id. Hup., Gay's Chile, p. 40. Cret.; Chile, Col.
 Id. *var. undulata*, Karst., Geog. Verh. N. Gren., p. 102, Pl. 1, f. 3.
ANCYLOCERAS HUMBOLDTIANA, Fbs., Q. J. G. S., v. 1, 175.
Not Orthoceras id., Lea, Tr. Amer. Phil. Soc., 2 s., v. 7, p. 253, Pl. 8, f. 1.
 See *Hamites Humboldtiana*. Cret.; Colombia.
A. BEYRICHI, Karst., G. V. N. Gren., p. 103, Pl. 1, f. 4. Cret.; Col.
A. SIMPLEX, d'Orb., Pal. Fr., Terr. Cr., p. 503, Pl. 125, f. 5-8.
Hamites elatior, Fbs., Darwin's S. A., p. 265. Cret.; Patagonia.
LINDIGIA HELIOCEROIDES, Karst., Geog. Verh. N. Gren., p. 103, Pl. 1, f. 5. Cret.; Col.

- AMMONITES **A**ALENSIS, Ziet., Wurt., Pl. 28, f. 3.
Id. d'Orb., P. Fr., T. Jur., p. 238, Pl. 63.
- A. candidus*, d'Orb., on plate.
Id. Burmeister & Giebel, 29. Jur.; Chile.
- A. ACOSTÆ*, Karst., Geog. Verh., N. Gren., p. 111, Pl. 5, f. 1. Cret.; Col.
- A. ACUTISSIMUS*, Gabb, new sp. Cret. ?; Peru.
- A. ÆGOCEROS*, Phil., Atacama, p. 142, Pl. 2, f. 3.
Id. Gabb, present paper. Jur.; Chile and Peru.
- A. ÆQUATORIALIS*, Von Buch, Petr., p. 15, f. 11-12. Cret.; Col.
- A. ANCEPS*, Rein. (sp.), d'Orb., Pal. Fr., T. Jur., p. 462, Pl. 166, 167.
Nautilus id., Reineke, Naut. & Am., p. 82, Pl. 7, f. 61.
- Perisphinctes id.*, Hyatt, P. Bost. N. H. Soc., v. 17, p. 368. Jur.; Brazil.
- A. ANDII*, Gabb, new sp. Jur.; Peru.
- A. ANNULATUS*, Sby., M. Con., vol. 3, p. 41, Pl. 222.
- A. annularis*, Phil., Atacama, p. 141. Col.; Chile.
- A. ATACAMENSIS*, Phil., Atacama, p. 142, Pl. 1, f. 1-2.
- A. sp. indet.*, Dana, W. Exped., Pl. 15, f. 6. Jur.; Chile & Peru.
- A. ATTENUATUS*, Hyatt (sp.) Peru.
- Buchiceras id.*, Hyatt, P. B. Soc. N. H., v. 17, p. 372. Cret.; Brazil.
- A. BARBACOENSIS*, Karst., Geog. Verh. N. Gren., p. 111, Pl. 4, fig. 5. Cret.; Col.
- A. BIFURCATUS*, Schlot., in Zieten, Pl. 3, fig. 3.
- A. Garantianus*, d'Orb., P. Fr., T. Jur., p. 377, Pl. 121.
- A. bifurcatus*, Bayle & Coquand, M. G. S. Fr., 2 s., v. 4, p. 20, Pl. 2, f. 2.
Id. Hup., Gay's Chile, p. 38. Ool.; Chile.
- A. BILOBATUS*, Hyatt (sp.)
- Buchiceras id.*, H., Proc. Bost. N. H. Soc., v. 17, p. 370. Cret.; Brazil, Peru.
- A. BISULCATUS*, Brug., Enc. Meth., v. 1, p. 39, No. 13.
Id. Hup., Gay's Chile, p. 32. Jurassic; Chile.
- A. BOGOTENSIS*, Fbs., Q. J. G. Soc., v. 1, p. 178. Cret.; Colombia.
- A. BOUSSINGAULTII*, d'Orb., Am. Mer., p. 68, Pl. 1, f. 1-2.
Id. d'Orb., Foss. Col., p. 32, Pl. 1, f. 1-2. Cret.; Col.
- A. BRACKENRIDGII*, Sby., M. Con., p. 187, Pl. 184.
Id. Phil., Atacama, p. 141. Ool.; Chile.
- A. BRODIEI*, Sby., M. Con., Pl. 351.
Id. Phil., Atacama, p. 140. Ool.; Chile.
- A. BUCHIANA*, Fbs., Q. J. G. Soc., v. 1, p. 177. Cret.; Colombia.
- A. CANALICULATUS*, Munst., in Zieten, p. 37, Pl. 28, f. 6.
Id. Hup. Gay's Chile, p. 38.
- A. opalinus*, Pusch., Quenst., Petr., Pl. 7, f. 10.
- Id.* B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 10, Pl. 2, f. 1. Lias.; Chile.
- A. CAQUESENSIS*, Karst., Geog. Verh. N. Gren., p. 104, Pl. 1, f. 7.
- A. ubaquensis*, K., loc. cit., p. 104, Pl. 1, f. 8. Cret.; Col.
- A. CARBONARIUS*, Gabb, new sp. Lias.; Peru.

- A. CERAS, Giebel, Fauna der Vorw., Ceph., p. 757.
Arnioceras id., Hyatt, Proc. B. S. N. H., v. 17, p. 366. Lias.; Peru.
- A. CODAZZIANUS, Karst., Geog. Verh. N. Gren., p. 108, Pl. 3, f. 4, 5. Cret.; Col.
- A. COLOMBIANUS, d'Orb., Am. Mer., p. 17, Pl. 17, f. 12-14.
Id. d'Orb., Foss. Coll., p. 41, Pl. 2, f. 12-14. Cret.; Colombia.
- A. COMMUNIS, Sby., M. Con., Pl. 117, f. 2-3.
Id. Phil., Atacama, p. 141. Lias.; Chile.
- A. CORNIFERUS, Gabb, new sp. Jur.; Peru.
- A. DAMSIANUS, d'Orb., A. Mer., p. 69, Pl. 2, f. 1-2.
Id. d'Orb., Foss. Col., p. 33, Pl. 2, f. 1-2. Cret.; Col.
- A. DOMEYKANUS, B. & C., M. G. S. Fr., 2 s., v. 4, p. 10, Pl. 2, f. 3-5.
Id. Hup., Gay's Chile, p. 36. Lias.; Chile.
- A. DUPINIANUS, d'Orb., P. Fr., T. Cr., p. 276, Pl. 81, f. 6-8.
Id. Karst., G. Verh. N. Gren., p. 412, Pl. 5, f. 5. Cret.; Col.
- A. FIMBRIATUS, Sby., M. Con., v. 2, p. 145, Pl. 164.
Id. Hup., Gay's Chile, p. 23. Jur.; Chile.
- A. GALEATUS, V. Buch, Petr. rec. par Humb., p. 12, Pl. 2, f. 20.
Id. d'Orb., Am. Mer., p. 75, Pl. 17, f. 3-7.
Id. d'Ob., Foss. Col., p. 37, Pl. 2, f. 3-7.
- A. *Tocaymensis*, Lea, Tr. A. Phil. Soc., 2 s., v. 7, p. 253, Pl. 8, f. 2. Cret.; Colombia.
- A. *Americanus*, Lea, *loc. cit.*, p. 255, Pl. 8, f. 6.
- A. *compressissimus*, d'Orb., Pal. Fr., T. Cr., v. 1, p. 210, Pl. 61, f. 4-5.
- A. *Didayanus*, d'Orb., *loc. cit.*, p. 360, Pl. 108, f. 4-5.
- A. *Leai*, Forbes, Quart. Jour. Geol. Soc., v. 1, p. 178.
- A. *galeatoides*, Karst. Verh. N. Gren., p. 107, Pl. 3, f. 1.
- A. *caicedi*, Karst., *loc. cit.*, p. 107, Pl. 3, f. 2.
- A. *Lindigii*, Karst., *loc. cit.*, p. 108, Pl. 3, f. 3. Cret.; Col.
- A. GAYI, Gabb.
- A. *tripartitus*, Huppé, Gay's Chile, p. 35, Pl. 1, f. 2.
- Not A. tripartitus*, Raspail. Jur.; Chile.
- This resembles *A. Boussingaultii*, d'Orb. (Cretaceous), but the two authors place their species in different formations. Apart from this, which may be an error on the part of one or the other, the species differ, according to the figures, in this species having fewer nodes on the middle of the whorl, and in each node sending a rib to the suture. The figure of d'Orbigny's species makes the umbilical half plain. Nevertheless, I have seen such great variation in the surface ornaments of the same species of Ammonites that, had the two forms been referred to the same geological age, I should have preferred calling the two by one name.
- A. GEMMATUS, Hup., Gay's Chile, p. 35, Pl. 1, f. 3. Jur.; Chile.
- A. GIBBONIANUS, Lea, Tr. A. P. S., 2 s., v. 7, p. 254, Pl. 8, f. 3.
Id. Hyatt, Hartt's Brazil, p. 389.
Id. Gabb, present paper. Cret.; Col., Peru, Brazil.

The North American form referred to this by Marcou and subsequent authors is a distinct but allied species. It increases much more rapidly in the size of the whorls, and they have a

flatter cross section. Strange to say, although it has been quoted half a dozen times, nobody has had more than imperfect fragments, and the septum is, as yet, unknown. Perhaps the impression named by Dana *A. Pickeringii* (q. v.) should be placed here.

A. HALLI, Meek & Hayden, Proc. Phila. Acad., 1856, p. 70.

Phylloceras? *id.*, Meek, Rep. Hayden's Survey, p. 458, Pl. 24, f. 3, *a, b, c.*

Id. Hyatt, Hartt's Brazil, p. 388.

Cret.; Brazil.

A. HARTTI, Hyatt (sp.).

Ceratites id., Hyatt, Hartt's Brazil, p. 386.

Cret.; Brazil.

A. HOPKINSII, Fbs., Q. J. G. S., v. 1, p. 176.

Cret.; Colombia.

A. HUGARDIANUS, d'Orb., P. Fr., T. Cret., v. 1, p. 291, Pl. 86, f. 1.

Id. V. Buch, Zeits. D. Geol. Gesell., v. 2, p. 342.

Cret.; Venez.

A. HYATTI, Gabb, new sp.

Jurassic; Peru.

A. INFLATUS, Sby., M. Con., p. 178.

Id. V. Buch, Zeits. D. Geol. Gesellschaft, v. 2, p. 341.

Cret.; Venez.

A. LEONHARDINUS, Karst., Geog. Verh., N. Gren., p. 106, Pl. 2, f. 5.

Cret.; Col.

A. LIGATUS, d'Orb., Pal. Fr., Terr. Cret., p. 126, Pl. 38.

A. Inca, Fbs., Q. J. G. S., v. 1, p. 176.

Cret.; Colombia.

A. LOSCOMBI, Hyatt (sp.).

Phylloceras id., H., Proc. Bost. N. H. Soc., v. 17, p. 368.

Lias.; Peru.

A. MACROCEPHALUS, Schlot., Taschenb., p. 70.

Id. Hup., Gay's Chile, p. 36.

A. corrugatus, Hup., on plate.

Stephanoceras id., Hyatt, P. B. S. N. H., v. 17, p. 368.

A. macrocephalus, Gabb, present paper.

Ool.; Chile, Bolivia, Peru.

A. MAYORIANUS, d'Orb., P. F., T. Cr., v. 1, p. 267, Pl. 79.

Id. V. Buch, Zeits. D. Geol. Gesell., v. 2, p. 342.

Cret.; Venez.

A. MISERABILIS, Quenst., Jura, p. 71.

Arnioceras id., Hyatt, P. B. S. N. H., v. 17, p. 367.

Lias.; Bolivia.

A. NOEGGERATHII, Karst., Geog. Verh., N. G., p. 104, Pl. 1, f. 6.

Cret.; Col.

A. MOSQUERÆ, Karst., Geog. Verh. N. G., p. 111, Pl. 4, f. 4.

Cret.; Col.

A. OCCIDENTALIS, Lea, Tr. A. P. S., 2 s., v. 7, p. 254, Pl. 8, f. 4.

A. Vanuxemensis, Lea, loc. cit., p. 254, Pl. 8, f. 5.

A. Alexandrinus, d'Orb., A. Mer., p. 75, Pl. 17, f. 8-11.

Cret.; Col.

A. OLLONENSIS, Gabb, new sp.

Cret.? Peru.

A. ORBIGNYI, Gabb, 1861, Proc. A. Phil. Soc., Syn. Cret., p. 14.

A. alternatus, d'Orb., A. Mer., p. 71, Pl. 1, f. 5-6.

Not id., Woodward, nor Portl.

Cret.; Colombia.

A. ORTONI, Hyatt (sp.).

Caloceras id., Hyatt, Pr. B. Soc. N. H., v. 17, p. 367.

Jur.? Peru.

A. PERARMATUS, Sby., M. Con., Pl. 352.

Id. Philippi, Atacama, p. 141.

Jur.; Chile.

A. PERUVIANUS, V. Buch, Petr., p. 5, f. 5-7.

Cret.; Colombia.

- A. PICKERINGII, Dana, Wilkes' Exped., p. 721, Pl. 15, f. 5. Cret.? Peru.
 See note to *A. Gibbonianus*.
- A. PEDERNALIS, V. Buch, Uber. Cerat., p. 31, Pl. 6, f. 8-10.
Ceratites Pierdenalis, Hyatt, Hartt's Brazil, p. 388.
Buchiceras Pierdernalis, Hyatt, P. Bost. N. H. Soc., v. 17, p. 369.
- A. *pleurisepta*, Conrad, Emory's Mex. Boundary Rep., p. 159, Pl. 15, f. 1. Cret.; Brazil.
- A. PLANIDORSATUS, d'Orb., Am. Mer., p. 72, Pl. 1, f. 6-9.
Id. d'Orb., Foss. Col., p. 36, Pl. 1, f. 6-9. Cret.; Col.
- A. PLICATILIS, Sby., Min. Conch., vol. 2, p. 148, Pl. 166.
A. biplex, Sby., *loc. cit.*, p. 168, Pl. 253.
Id. Hup., Gay's Chile, p. 34. Jur.; Chile.
- A. PUSTULIFER, B. & C., M. G. S. Fr., 2 s., v. 4, p. 141, Pl. 1, f. 3. ? Lias.; Chile.
- A. RADIANUS, Schlot., Petr., p. 28, No. 34.
Id. Huppé, Gay's Chile, p. 34.
Id. Philippi, Atacama, p. 141. Lias.; Chile.
- A. RAIMONDIANUS, Gabb, new sp. Jur.; Peru.
- A. RHOTOMAGENSIS, Brogn., Env. Paris, p. 83, Pl. 4, f. 2.
 ? *Id.* V. Buch, Petr., p. 7, f. 15.
- A. *verrucosus*, Hup., Gay's Chile, p. 39, Pl. 1, f. 4.
Not id. d'Orb., Pal. Fr., T. Cret., p. 191, Pl. 58, f. 1-3. Cret.; Chile, Colombia.
- A. *Ancyloceras Buchianus*, d'Orb., Prod. Pal., vol. 2, p. 101.
- A. ROISSYANUS, d'Orb., Pal. Fr., Terr. Cret., v. 1, p. 302, Pl. 89.
Id. V. Buch, Zeits. D. Geol. Gesell., v. 2, p. 342. Cret.; Venez.
- A. ROSEANUS, Karst., Geog. Verh., N. Gren., p. 106, Pl. 2, f. 4. Cret.; Col.
- A. ROTUNDUS, Sby., M. Con., Pl. 293, f. 3.
Id. Phil., Atacama, p. 141. Jur.; Chile.
- A. SANCTAFECINUS, d'Orb., A. Mer., p. 70, Pl. 1, f. 3-4.
Id. d'Orb., Foss. Col., p. 34, Pl. 1, f. 3-4. Cret.; Chile.
- A. SERRATUS, Hyatt (sp.).
Buchiceras id., Hyatt, P. Bost. S. N. H., v. 17, p. 370. Cret.; Brazil.
- A. SYRIACIFORMIS, Hyatt (sp.).
Buchiceras id., H., Pr. B. S. N. H., v. 17, p. 371. Cret.; Brazil.
- A. TOROANUS, Karst., G. Verh. N. Gren., p. 109, Pl. 4, f. 2. Cret.; Col.
- A. TREFFRYANUS, Karst., *loc. cit.*, p. 109, Pl. 4, f. 1. Cret.; Col.
- A. TRIONÆ, Karst., Geog. Verh. N. G., p. 105, Pl. 2, f. 3. Cret.; Col.
- A. TUCUYENSIS, V. Buch, Zeitsch. Deutsch. Geol. Gesell., vol. 2, p. 342, Pl. 10. Cret.; Venez.
- A. VARIABILIS, d'Orb., Pal. Fr., T. Jur., v. 1, p. 350, Pl. 113.
Id. Burmeister & Giebel, p. 29. Lias.; Chile.
- A. VARICOSUS, Sby., M. Con., p. 451.
Id. V. Buch, Zeits. D. Geol. Gesell., v. 2, p. 341. Cret.; Venez.
- A. VENTANILLENSIS, Gabb, new sp. Jurassic; Peru.
- TRIGONELLITES LANCEOLATUS, Gabb.
Aptychus, sp. *indet.*, Phil., Atacama, p. 143, Pl. 1, f. 3. Jurassic; Chile.

GASTEROPODA.

- NEPUNEA CHILENSIS, d'Orb. (sp.).
Fusus id., d'Orb., Voy. Astr. & Zel., Pl. 4, f. 29. Cret.; Chile.
 N. (*Tritonofusus*) DIFFICILIS, d'Orb. (sp.).
Fusus id., d'Orb., Am. Mer., p. 118, Pl. 12, f. 11-12.
Id. d'Orb., Ast. & Zel., Pl. 4, f. 27, 28.
Id. Hup., Gay's Chile, p. 171.
Neptunea id., Gabb, Syn. Cret., 1861, p. 62. Cret.; Chile.
 PERISSOLAX HOMBRONIANA, d'Orb. (sp.).
Pyrula id., d'Orb., Voy. Ast. & Zel., Pl. 4, f. 31.
P. dilatata, Hup., Gay's Chile, p. 179, Pl. 2, f. 2.
Perissolax Hombroniana, Gabb, Syn. Cret., p. 67. Cret.; Chile.
 P. DURVILLEI, d'Orb. (sp.).
Fusus id., d'Orb., Astr. & Zel., Pl. 5, f. 1.
Perissolax id., Gabb, Syn. Cret., p. 67. Cret.; Chile.
 P. LONGIROSTRIS, d'Orb. (sp.).
Pyrula id., d'Orb., Am. Mer., p. 119, Pl. 12, f. 13.
Id. d'Orb., Astr. & Zel., Pl. 4, f. 30.
Perissolax id., G., Syn. Cret., 1861, p. 67. Cret.; Chile.
 P. TROCHOIDES, Gabb, new sp. Cret.; Peru.
 SURCULA ARATA, Gabb.
Pleurotoma id., Gabb, P. A. N. S., Phila., 1861, p. 198, Pl. 3, f. 9. Cret.; Chile.
 DRILLIA SUBEQUALIS, Sby. (sp.).
Pleurotoma id., Sby., Darwin, p. 257, Pl. 4, f. 52. Cret.; Chile.
 BELA ORBIGNYANA, Gabb.
Pleurotoma id., G., loc. cit., p. 198, Pl. 3, f. 7. Cret.; Chile.
 B. ARAUCANA, d'Orb. (sp.).
Pleurotoma id., d'Orb., A. Mer., p. 119, Pl. 14, f. 10-11.
Id. d'Orb., Ast. & Zel., Pl. 4, f. 35-36.
Id. Hup., Gay, p. 177. Cret.; Chile.
 LUNATIA ARAUCANA, d'Orb. (sp.).
Natica id., d'Orb., Am. Mer., p. 115, Pl. 12, f. 4-5.
Id. Hup., Gay's Chile, p. 222.
N. australis, d'Orb., Ast. & Zel., Pl. 4, f. 20-21.
Id. Gay, p. 223. Cret.; Chile.
 LUNATIA SOLIDA, Sby. (sp.).
Natica id., Sby., Darwin's S. A., p. 255, Pl. 3, f. 40-41. Cret.; Chile, Patagonia.
 PRISCONATICA? GIBBONIANA, Lea (sp.).
Natica id., Lea, Tr. A. P. S. Phil., 2 s., v. 7, p. 256, Pl. 9, f. 10. Cret.; Colombia.
 P. AMPLA, Gabb, new sp. Cret.; Peru.
 P. INCONSPICUA, Gabb, new sp. Cret.; Peru.
 P. OVOIDEA, Gabb, new sp. Cret.? Peru.
 P. PRÆLONGA, Leym. (sp.).

Natica id., Leym., Mem. Geol. Soc. Fr., v. 5, p. 13, Pl. 16, f. 8.

Id. d'Orb., Pal. Fr., T. Cret., v. 2, p. 339, Pl. 172, f. 1.

Id. d'Orb., Am. Mer., p. 78, Pl. 18, f. 1.

Id. Von Buch, Zeits. Deutsch. G. Gesell., v. 2, p. 343.

Id. Hyatt, Hartt's Brazil, p. 385.

Cret.; Venez., Col., & Brazil.

GYRODES AUCA, d'Orb. (sp.).

Natica id., d'Orb., Ast. & Zel., Pl. 4, f. 22-23.

N. Chilina, d'Orb., *loc. cit.*, f. 24-26.

Cret.; Chile.

I place both these names of d'Orbigny's as synonyms because, although the two sets of figures seem to differ, I do not find the differences sustained by specimens from Chile in the Academy's museum. The cross sections of the body whorl, the only character on which the author relied, seem to vary even more than his figures, and to gradate from one form to the other.

G. CONTRACTA, Gabb, new sp.

Lias.; Peru.

G. LIBATA, Gabb, new sp.

Cret.; Peru.

RUMA GRANGEANUS, d'Orb. (sp.).

Natica id., d'Orb., Ast. & Zel., Pl. 4, f. 18-19.

Cret.; Chile.

? NEVERITA PHASIANELLA, Bayle & Coquand (sp.).

Natica id., B. & C., M. G. S. Fr., 2 s., v. 4, p. 23, Pl. 2, f. 9.

Id. Huppé, Gay's Chile, p. 224.

Cret.; Chile.

NEVERITA STRIOLATA, Sby., Darwin's S. A., p. 255, Pl. 5, f. 39.

Cret.; Chile.

NATICA ORBIGNYI, Huppé, Gay, p. 224.

Cret.; Chile.

SCALA (*Opalia*) AUCA, d'Orb.

Scalaria auca, d'Orb., Ast. & Zel., Pl. 4, f. 16-17.

Cret.; Chile.

?S. CHILENSIS, d'Orb., Am. Mer., p. 114, Pl. 14, f. 1-2.

Id. Hup., Gay's Chile, p. 152.

Cret.; Chile.

Possibly not a *Scala*, but figure and description are alike too poor to warrant an opinion.

S. (*Clathrus*) PATTONI, Gabb.

S. (*C.*) *Chilensis*, Gabb, P. Phil. Acad. 1860, p. 197, Pl. 3, f. 4.

Not *S. Chilensis*, d'Orb.

Scala Pattoni, Gabb, Proc. A. P. Soc. Phila., vol. 8, p. 135.

S. Gabbi, Remond, Pal. Chile, p. 31.

Cret.; Chile.

In case d'Orbigny's species should prove to belong to another genus, then the old name for this must be restored.

TYLOSTOMA VARIABILIS, Gabb, Pal. Cal., v. 2, p. 261, Pl. 35, f. 6.

Id. Gabb, present paper.

Cret.; Peru.

CINULIA CHILENSIS, d'Orb. (sp.).

Avellana id., d'Orb., Ast. & Zel., Pl. 4, f. 32-34.

Cret.; Chile.

C. ANTIQUA, Gabb, new sp.

ACTÆONELLA OVIFORMIS, Gabb, new sp.

Cret.; Peru.

LOXONEMA POTOSENSIS, d'Orb., Prod. Pal., v. 1, p. 172.

Chemnitzia Potosensis, d'Orb., A. Mer., p. 60, Pl. 6, f. 1-3.

Melania, on plate.

Trias.; Bolivia.

PUGNELLUS UNCATUS, Forbes (sp.), Gabb, Syn. Cret., p. 72.

Strombus id., Fbs., Tr. G. Soc. Lond., v. 7, p. 129, Pl. 13, f. 6.

S. semicostatus, d'Orb., Astr. & Zelee, Pl. 5, f. 38-39.

Colombellina uncata, d'Orb., Prod. Pal., v. 2, p. 231.

Pugnellus id., Rémond, Pal. Chile, p. 30.

Cret.; Patagonia.?

I place this species in the list because Rémond attributes it to Port Famine. At the same time I doubt the propriety, suspecting that a confusion has arisen from the fact that it was refigured by d'Orbigny in the report of the voyage of the *Astrolabe* and *Zelée* in a mixture of South American and East Indian species.

PUGNELLUS TUMIDUS, Gabb, Proc. A. N. S. of Phila., 1860, p. 197, Pl. 3, f. 13-14. Cret.; Chile.

?*HIPPOCHRENES BOUSSINGAULTII*, d'Orb. sp.

Rostellaria id., d'Orb., Am. Mer., p. 80, Pl. 18, f. 5.

Id. d'Orb., Foss. Col., p. 45, Pl. 3, f. 5.

Cret.; Col.

Not a true *Hippochrenes* of the type of *H. macroptera*, but nearer to that than to any named genus. The expanded lip suddenly narrows in the middle to a narrow tongue. But it will subserve no good end to give generic names to each shape of lip in the protean group of alate shells, as I have already pointed out in my notes on the genus *Anchura*. If species of this type were numerous it would aid classification to give them a distinctive name; but where but a single species is known it results rather in confusion than simplification, to multiply names.

ANCHURA AMERICANA, d'Orb. (sp.).

Rostellaria id., d'Orb., Am. Mer., p. 80, Pl. 18, f. 5.

Id. d'Orb., Foss. Col., p. 45, Pl. 3.

Cret.; Colombia.

Not A. (Rost.) Americana, Evans & Shumard (N. Amer.).

A. ANGULOSA, d'Orb. (sp.).

Rostellaria id., d'Orb., Am. Mer., p. 80, Pl. 18, f. 4.

Cret.; Col.

TURRITELLA PERUANA, Gabb, new sp.

Cret.; Peru.

T. RAIMONDII, Gabb, new sp.

Lias.; Peru.

LITHOTROCHUS HUMBOLDTII, Von Buch (sp.).

Pleurotomaria id., Von Buch, Petr., p. 9, f. 26.

Turritella Andii, d'Orb., Am. Mer., p. 104, Pl. 6, f. 11.

Lithotrochus Andii, Con., U. S. Astron. Exped., p. 233, Pl. 41, f. 3.

Trochus Struveanus, Zim., Dunk., Pal., p. 185, Pl. 26, f. 2.

Turritella Humboldtii, Boyle & Coq., M. G. S. Fr., 2 s., v. 4, p. 12, Pl. 2, f. 7-8.

Id. Gabb, Syn. Cret., p. 90.

T. Andii, Hup., Gay's Chile, p. 156.

Cret.; Chile, Peru, Bolivia, and Colombia.

PETROPOMA PERUANA, Gabb, new sp.

Lias.; Peru.

DENTALIUM CHILENSE, d'Orb., Ast. & Zel., Pl. 4, f. 37-38.

Cret.; Chile.

PATELLA AUCA, Gabb, Proc. Acad. N. S. of Phila., 1860, p. 198, Pl. 3, f. 11.

Cret.; Chile.

HELICION CARBONARIUS, Gabb, new sp.

Lias.; Peru.

ACTÆON AFFINIS, Fitt (sp.), d'Orb., Pal. Fr., T. Cr., Pl. 168, f. 46.

Tornatella id., Fitt., Tr. G. S. Lond., v. 4, Pl. 18, f. 9.

Actæon id., d'Orb., A. Mer., p. 79.

Cret.; Colombia.

A. ORNATA, d'Orb., A. Mer., p. 79.

Cret.; Col.

A. SEMINOSA, Gabb.

Eulima id., G., Proc. Acad. N. S. of Phila., 1860, p. 197, Pl. 3, f. 6. Cret.; Chile.

With a very *Eulimoid* form, this shell proves to have a strong fold on the inner lip.

BULLA CHILENSIS, d'Orb., Ast. & Zel., Pl. 4, f. 13-15. Cret.; Chile.

LAMELLIBRANCHIATA.

CULTELLUS AUSTRALIS, Gabb, P. A. N. S., Phila., 1860, p. 198, Pl. 3, f. 8. Cret.; Chile.

PANOPÆA COQUIMBENSIS, d'Orb., A. Mer., p. 126, Pl. 15, f. 7-8.

Id. Huppé, Gay's Chile, p. 373. Cret.; Chile.

P. SIMPLEX, Hup., Gay, p. 374, Pl. 6, f. 7. Cret.; Chile.

Lutraria on plate.

? *P. TURGIDA*, Hup., Gay, p. 375, Pl. 6, f. 3.

Donax id., on plate. Jur.; Chile.

P. UNDULATA, Gabb, new sp. Cret.; Peru.

CORBULA CHILENSIS, d'Orb., Ast. & Zel., Pl. 5, f. 11-12. Cret.; Chile.

C. COLUMBIANA, d'Orb., Am. Mer., p. 84. Cret.; Col.

C. CORBULOOPSIS, Gabb.

Thracia id., Gabb, Proc. Acad. N. S. of Phila., 1860, p. 198, Pl. 3, f. 1. Cret.; Chile.

C. NUCULOIDES, Gabb, new sp. Lias.; Peru.

C. PERUANA, Gabb, new sp. Lias.; Peru.

C. RAIMONDII, Gabb, new sp. Lias.; Peru.

ANATINA COLOMBIANA, d'Orb., A. Mer., p. 84, Pl. 18, f. 16-17.

Id. d'Orb., Foss. Col., p. 49, Pl. 3, f. 16-17. Cret.; Col.

PHOLADOMYA ABBREVIATA, Hup., Gay, p. 377, Pl. 6, f. 4. Jur.; Chile.

P. ACOSTÆ, B. & C., M. G. S. Fr., v. 4, p. 21, Pl. 7, f. 5-6.

Id. Hup., Gay's Chile, p. 377. Jur.; Chile.

P. AUSTRALIS, Gabb, new sp. Cret.; Peru.

P. FIDICULA, Sby., M. Con., Pl. 225.

Id. B. & Coq., M. G. S. Fr., 2 s., v. 5, p. 27, Pl. 7, f. 7.

Id. Hup., Gay's Chile, b. 376.

P. attenuata, Hup., Gay's Chile, p. 376, Pl. 6, f. 5. Jur.; Chile.

P. RAIMONDII, Gabb, new sp. Cret.; Peru.

P. ZIETENII, Agas. Etud. sur les Myes, p. 54, Pl. 3, f. 13-15.

P. fidicula, Ziet. (not Sby.).

P. Zieteni, Bayle & Coquand, Huppé, Gabb. Jur.; Peru, Chile.

HOMOMYA INCURVA, Gabb, new sp. Cret.? Jur.? Peru

H. LÆVIGATA, Huppé (sp.).

Pholadomya id., Hup., Gay, p. 378, Pl. 6, f. 6. Jur.; Chile.

H. PONDEROSA, Gabb, new sp. Cret.; Peru.

MACTRA ARAUCANA, d'Orb., A. Mer., p. 125, Pl. 15, f. 3-4.

Id. Hup., Gay, p. 349.

Id. d'Orb., Ast. & Zel., Pl. 5, f. 2-4. Cret.; Chile.

Id. var. Gabb, Proc. Acad. N. S. of Phila., 1860, p. 198. Cret.; Chile.

M. CHILENSIS, Gabb, loc. cit., p. 198, Pl. 3, f. 5. Cret.; Chile.

Both these species bear a marked resemblance externally to my genus *Cymbophora*, but I have not placed them under that name since the proof, in the hinge characters, has never yet been attained. They are not true *Mactras* in the restricted sense.

- ? *LUTRARIA CUNEIFORMIS*, Hup., Gay, p. 351, Pl. 3, f. 8. Cret.; Chile.
- TELLINA LARGILLIERTI*, d'Orb., Ast. & Zel., Pl. 5, f. 5-6.
- Nucula id.*, d'Orb., Am. Mer., p. 128, Pl. 15, f. 9-10. Cret.; Col.
- T. PERNAMBUCENSIS*, Rath., Proc. Bost. N. H. Soc., v. 17, p. 256. Cret.; Brazil.
- T. PERUANA*, Gabb, new sp. Lias.; Peru.
- ? *T. VALDIVIANA*, d'Orb. (sp.).
- Arcopagia id.*, d'Orb., Ast. & Zel., Pl. 5, f. 7-8. Cret.; Chile.
- CYPRIMERIA PERUVIANA*, Con., Jour. Conch., 1866, p. 105, Pl. 9, f. 1. Cret.; Peru.
- ? *VENUS ÆREA*, Hup., Gay, p. 338. Cret.; Chile.
- ? *V. AUCA*, d'Orb., A. Mer., p. 122, Pl. 12, f. 17-18.
- Id.* d'Orb., Ast. & Zel., Pl. 5, f. 9-10.
- Id.* Hup., Gay, p. 341. Cret.; Chile.
- ? *V. CHIA*, d'Orb., A. Mer., p. 82, Pl. 18, f. 9-10. Cret.; Col.
- ? *V. CRETACEA*, d'Orb., A. Mer., p. 82. Cret.; Col.
- ? *V. DUBIA*, Hup., Gay, p. 344, Pl. 6, f. 9. Jur.; Chile.
- ? *V. INSULA*, Hup., Gay, p. 343, Pl. 6, f. 10. Cret.; Chile.
- V. CECILIANA*, d'Orb. (sp.).
- Mactra id.*, d'Orb., A. Mer., p. 126, Pl. 15, f. 5-6.
- Venus Orbignyi*, Gabb, P. A. N. S., Phila., 1860, p. 198, Pl. 3, f. 2. Cret.; Chile.
- CALLISTA McGRATHIANA*, Rath., P. Bost. N. H. Soc., v. 17, p. 255. Cret.; Brazil.
- CARDIUM ACUTICOSTATUM*, d'Orb., A. Mer., p. 120, Pl. 12, f. 11-12.
- Id.* d'Orb., Ast. & Zel., Pl. 5, f. 17-20. Cret.; Chile.
- C. (Protocardia) APPRESSUM*, Gabb, new sp. Lias.; Peru.
- C. (P) PEREGRINORSUM*, d'Orb., A. Mer., p. 81, Pl. 18, f. 6-8. Cret.; Col., Venez.
- Id.* V. Buch, Zeits. D. Geol. Gesell., v. 2, p. 343.
- C. (Trachycardium) AUCA*, d'Orb., A. Mer., p. 121, Pl. 13, f. 14-15.
- C. id.*, Huppé, Gay, p. 325. Cret.; Chile.
- C. (T.) AUSTRALINUM*, d'Orb.
- C. Australinum*, d'Orb., Prod., vol. 2, p. 242.
- C. Australe*, d'Orb., Ast. & Zel., Pl. 5, f. 21-22. Cret.; Chile.
- C. (T.) COLOMBIANUM*, d'Orb.
- C. Colombianum*, d'Orb., A. Mer., p. 82. Cret.; Col.
- C. (Criocardium) SOARESANUM*, Rath.
- C. id.*, Rath., P. Bost. N. H. Soc., v. 17, p. 253. Cret.; Brazil.
- C. (C.) STRIATELLUM*, Philippi.
- C. striatellum*, Phil., Atacama, p. 143, Pl. 2, f. 6. Lias.? Chile.
- LUCINA AMERICANA*, Forbes, Darwin's S. A., p. 266, Pl. 5, f. 24. Age? Peru.
- L. DEMOULINI*, d'Orb., Ast. & Zel., Pl. 5, f. 15-16. Cret.; Chile.
- L. EXCENTRICA*, Sby., Darwin's S. A., p. 267, Pl. 5, f. 21. Cret.; Pat.
- L. GRANGEI*, d'Orb., Ast. & Zel., Pl. 5, f. 13-14. Cret.; Chile.

- L. PLICATO-COSTATA, d'Orb., A. Mer., p. 83, Pl. 15, f. 13-14.
Id. d'Orb., F. Col., p. 48, Pl. 3, f. 13-14. Cret.; Col., Venez.
Id. Von Buch; Zeits. D. G. Gesell., v. 2, p. 344.
- L. TENELLA, Rath., Pr. Bost. N. H. Soc., v. 17, p. 253. Cret.; Brazil.
 ASTARTE DARWINII, Fbr., Darwin's S. A., p. 266, Pl. 5, f. 22-23. Age? Chile.
 A. DUBIA, d'Orb., A. Mer., p. 105, Pl. 6, f. 12-13. Cret.; Chile.
 ?A. GREGARIA, Phil., Atacama, p. 143, Pl. 2, f. 4. Jur.; Chile.
 A. TRUNCATA, V. Buch, Petr., p. 13, f. 17. Cret.; Col.
 ?CRASSATELLA BOGOTINA, d'Orb. (sp.).
Tellina id., d'Orb., A. Mer., p. 84, Pl. 18, f. 15. Cret.; Col.
 C. BUCHIANA, Karst., Geog. Verh. N. Gren., p. 113, Pl. 5, f. 7. Cret.; Col.
 Most probably not a Crassatella.
- C. CAUDATA, Gabb, new sp. Lias.; Peru.
 ?C. VENERIFORMIS, Hup., Gay, p. 362, Pl. 6, f. 11. Cret.; Chile.
 CARDITA EXOTICA, d'Orb. (sp.), Gabb, present paper.
Astarte id., d'Orb., A. Mer., p. 83, Pl. 18, f. 11-12. Cret.; Col., Peru.
 C. (*Cyclocardia*) CIRCULARIS, Gabb, new sp. Cret.? Peru.
 VENERICARDIA MORGANIANA, Rath. (sp.).
Cardita id., Rath., Proc. Bost. S. N. H.; v. 17, p. 250. Cret.; Brazil.
 V. WILMOTH, Rath. (sp.).
Cardita id., Rath., P. B. S. N. H., v. 17, p. 251. Cret.; Brazil.
 MYTILUS ARAUCANUS, d'Orb., Ast. & Zel., Pl. 5, f. 27-28. Cret.; Chile.
 LITHOPHAGA AUSTRALIS, Gabb.
Modiola cretacea, G., Proc. Acad. N. S., Phil., 1860, p. 198, Pl. 3, f. 3.
Lithodomus Australis, G. Syn. Cret., p. 138. Cret.; Chile.
 M. SCALPRUM, Sby., M. Con., Pl. 248, f. 2.
Mytilus id., Goldf., Petr., Pl. 130, f. 9.
Id. B. & Coq., M. G. S. Fr., p. 15, Pl. 7, f. 3-4. Lias.; Chile.
 M. SOCORRINA, d'Orb., A. Mer., p. 90, Pl. 18, f. 18.
M. orsocrina, d'Orb. (*err. typ.*), Foss. Col., p. 56. Cret.; Col.
 MYOCONCHA ENIGMATICA, Hup. (sp.).
Cardita id., Huppé, Gay's Chile, p. 320, Pl. 5, f. 6. Jur.; Chile.
 M. MYTILOIDES, Hup. (sp.).
Cardita id., Hup., Gay, p. 321. Jur.; Chile.
 HIPPOPODIUM VALENCIENESII, B. & C. (sp.).
Cardita id., B. & C., M. G. S. Fr., 2 s., v. 4, p. 16, Pl. 6, f. 1-2. Jur.; Chile.
 LITHODOMUS SOCIALIS, d'Orb., A. Mer., p. 91. Cret.; Chile.
 PTERIA INCONSPICUA, Gabb, new sp. Lias.; Peru.
 PERNA AMERICANA, Forbes, Darwin's S. A., p. 266, Pl. 5, f. 4-6. Jur.; Chile.
 INOCERAMUS LUNATUS, Forbes, Quart. J. G. Soc., v. 1, p. 179. Cret.; Col.
 I. PLICATUS, d'Orb., A. Mer., p. 91, Pl. 18, f. 19. Cret.; Col., Venez.
Id. Von Buch, Zeits. D. G. Gesell., v. 2, p. 344.
 ? I. ROEMERI, Karst., G. Verh. N. Gren., p. 112, Pl. 5, fig. 6. Cret.; Col.
 Probably not an *Inoceramus*.

- TRIGONIA ABRUPTA, V. Buch, Petr., p. 17, f. 21-22.
Id. d'Orb., Am. Mer., p. 86, Pl. 19, f. 4-6. Cret.; Col.
- T. BRONNI, Agas. Etud., p. 18, Pl. 5, f. 19.
Lyrodon clavellatum, Bronn, Leth., Pl. 20, f. 3.
Not T. id., Sby., M. Con., Pl. 87.
T. Bronni, Gabb, present paper. Jurassic; Peru.
- T. CATENIFERA, Hup., Gay's Chile, p. 328, Pl. 5, f. 8.
T. catenata on plate. Jurassic; Chile.
- T. DELAFOSSEI, Bayle & Coq., M. G. Soc. Fr., 2 s., v. 4, p. 37, Pl. 8, f. 27.
Id. Hup., Gay, p. 328. Cret.; Chile.
- ? T. DOMEYKANA, Phil., Atacama, p. 144, Pl. 1, f. 5-6. Jur.; Chile.
- T. HANETIANA, d'Orb., Am. Mer., p. 127, Pl. 12, f. 14-16.
Id. d'Orb., Ast. & Zel., Pl. 5, f. 23-24.
Id. Hup., Gay, p. 327. Cret.; Chile.
- T. obtusa*, Hup., *id.*, p. 327, Pl. 5, f. 9.
- T. GIBBONIANA, Lea, Tr. A. P. S., 2 s., v. 7, p. 255, Pl. 9, f. 7.
T. Hondaana, Lea, *loc. cit.*, p. 256, Pl. 9, f. 9.
Id. d'Orb., A. Mer., p. 85, Pl. 19, f. 1-3.
T. Boussingaultii, d'Orb., Foss. Col., Pl. 4, f. 1-9.
T. Hondaana, d'Orb., *loc. cit.*, p. 50.
Not T. Gibboniana, Gabb, Pal. Cal., v. 1, p. 190, Pl. 17, f. 178; Pl. 31, f. 262.
Nor id. Gabb, *loc. cit.*, vol. 2, p. 248. Cret.; Colombia.
- I have compared Mr. Lea's types of the two names and find they are undoubtedly the same species, and on comparing them with the Californian form, they prove to be quite distinct.
- T. HUMBOLDTHI, V. B., Petr., p. 9, f. 28-30. Cret.; Col
- T. LAJOYI, Desh., Leym., M. G. S. Fr., v. 5, Pl. 8, f. 4.
Id. d'Orb., A. Mer., p. 87, Pl. 19, f. 10-11. Cret.; Col.
- T. longa*, Agas., Etud. Trigon., No. 47, Pl. 8, f. 1.
- T. LORENTI, Dana, Wilkes' Exped., p. 721, Pl. 15, f. 2.
Id. G., present paper. Jur.; Peru.
- T. SUBCRENULATA, d'Orb., A. Mer., p. 87, Pl. 19, f. 7-9. Cret.; Col
- T. TOCAIMAANA, Lea, Trans. A. P. S., 2 s., v. 7, p. 256, Pl. 9, f. 8.
T. alæformis, Von Buch, Petr., p. 8, Pl. 1, f. 10.
Id. d'Orb., A. Mer., p. 88, Pl. 20, f. 1.
- Not id.* Sby., M. Con., Pl. 3, f. 27.
- I had coincided with the two above-quoted authors in believing this shell to be the same as the English form until, since I have been at work at the present paper, Mr. Lea kindly loaned me his specimens, and I find, on a critical comparison with authentic English specimens, that there are small, though constant specific differences.
- MYOPHORIA SPIRALIS, Gabb, new sp. Lias.; Peru.
- POSIDONOMYA BECHERI, var. *Liasana*, Bronn, Leth., p. 342, Pl. 18, f. 23.
Id. Phil., Atacama, p. 144, Pl. 1, fig. 7. Lias.; Chile.
- ARCA ARAUCANA, d'Orb., A. Mer., p. 129, Pl. 13, f. 1-2. Cret.; Chile.

- A. ORESTIS, Rath., P. Bost. N. H. Soc., v. 17, p. 247. Cret.; Brazil.
 ? A. OVALIS, Gabb, new sp. Cret.; Peru.
 A. PEROBLIQUA, V. Buch, Petr., p. 16, figs. 13-14. Cret.; Col.
 A. ROSTELLATA, V. Buch, *id.*, p. 14, f. 16. Cret.; Col.
 A. SANTIAGUENSIS, Hup., Gay, p. 300, Pl. 5, f. 10.
 A. *Huidobrii* on plate. Jur.; Chile.
 A. TOCAYMENSIS, d'Orb., Prod., v. 2, p. 107.
Cucullæa id., d'Orb., A. Mer., p. 90, Pl. 21, f. 1-3. Cret.; Col.
 BARBATIA RAIMONDII, Gabb, new sp. Lias.; Peru.
 CUCULLÆA (*Trigonarca?*) BREVIS, d'Orb., A. Mer., p. 89, Pl. 20, f. 2-4.
Arca id., d'Orb., Prod., v. 2, p. 106.
C. id., Gabb, present paper. Cret.; Peru, Col.
 C. GABRIELIS, Leym., M. G. S. Fr., v. 5, Pl. 7, f. 5.
Arca id., d'Orb., Prod., v. 2, p. 80.
C. dilatata, d'Orb., A. Mer., p. 89, Pl. 20, f. 5-7. Cret.; Col.
 CUCULLÆA HARTII, Rath.
Arca (Cuc.) id., Rath., P. B. N. H. Soc., v. 17, p. 249. Cret.; Brazil.
 C. (*Trigonarca?*) ORBIGNYANA, Gabb, new sp. Cret.; Peru.
 C. (*Trigonarca*) PERUANA, Gabb, new sp. Cret.; Peru.
 C. SUBCENTRALIS, Rath., P. B. N. H. Soc., v. 17, 249. Cret.; Brazil.
 NUCULA? ALBERTINA, d'Orb., Ast. & Zel., Pl. 5, f. 25-26. Cret.; Chile.
 This shell, evidently described without seeing the hinge, looks to me more like one of the *Veneridæ*, than a *Nucula*.
 N. MARIÆ, Rath., Proc. Bost. N. H. Soc., v. 17, p. 244. Cret.; Brazil.
 N. PERUANA, Gabb, new sp. Lias.; Peru.
 ? N. INCERTA, d'Orb., A. Mer., p. 85.
Id. d'Orb., Foss. Col., p. 50. Cret.; Col.
 NUCULANA SWIFTIANA, Rath. (sp.).
Leda id., Rath., Proc. Bost. N. H. Soc., v. 17, p. 245. Cret.; Brazil.
 N. BRAZILIANA, Rath. (sp.).
Leda id., Rath., *loc. cit.*, p. 246. Cret.; Brazil.
 PECTEN ABNORMIS, Hup., Gay's Chile, p. 292, Pl. 5, f. 3. Jur.; Chile.
 P. ARGENTARIUS, Gabb, new sp. ? Jur.; Peru.
 " ? P. (*Terebratula?*) " DESERTI, Phil., Atacama, p. 145, Pl. 1, f. 9. Jur.; Chile.
 PECTEN GRANULATUS, d'Orb., Ast. & Zel., Pl. 5, f. 29-30. Cret.; Chile.
 P. RAIMONDII, Gabb, new sp. Jur.? Chile.
 P. UNGUIFERUS, Hup., Gay's Chile, p. 292, Pl. 5, f. 1. Jur.; Chile.
 PLEURONOCES CHILENSIS, d'Orb. (sp.).
Pecten id., d'Orb., Ast. & Zel., Pl. 5, f. 31, 32. Cret.; Chile.
 NEITHEA ALATA, V. Buch (sp.).
Pecten alatus, V. B., Petr., p. 3, Pl. 1, f. 1-4.
 P. *Dufrenoyi*, d'Orb., A. Mer., p. 106, Pl. 22, f. 5-9.
Id. Hup., Gay's Chile, p. 291.

P. alatus, Bayle & Coq., M. G. Soc. Fr., 2 s., v. 4, p. 14, Pl. 5, f. 1-2.

Id. Con., U. S. Astron. Exped., p. 283, Pl. 41, f. 2.

Janira id., Rem., Pal. Chile, p. 18.

Neithea id., G., Syn. Cret., p. 147.

From Colombia to Chile.

The age of this fossil has been the cause of great difference of opinion. Dr. Raimondi calls his specimens Jurassic, with some doubt. D'Orbigny places it in the Neocomien, while others carry it as low as the Lias. If it is older than Cretaceous it is the only species of the genus that is found outside of the limits of that formation. My own opinion is that it is somewhat high in the Cretaceous; not only from the fact that the genus is eminently characteristic of the chalk and green sand; but because all of the other fossils, sent with it by Humboldt and Degenhardt from Colombia to Von Buch, as well as the additional species collected by Dr. Gibbon and described by Dr. Lea, and, again the third collection, described from the same region by Forbes, all seem to belong to the age of the white chalk, or not far below it.

NEITHEA QUINQUECOSTATA, Sby. (sp.).

Pecten id., Sby., M. Con., Pl. 56.

Janira id., d'Orb., P. Fr., T. Cret., p. 632, Pl. 444, f. 1-5.

Neithea id., Gabb, Syn. Cret., 1861, p. 148.

Id. Gabb, present paper.

Cret.; Peru.

LIMA RARICOSTA, Bayle & Coq., M. G. S. Fr., 2 s., v. 4, p. 26, Pl. 6, f. 3-4.

Jur.; Chile.

L. (*Plagiostoma*) TRUNCATIFRONS, B. & C., *loc. cit.*, p. 25, Pl. 6, f. 5.

Id.

Hup., Gay's Chile, p. 296.

Jur.; Chile.

L. (*P.*) DUBIA, Hup., Gay, p. 297, Pl. 9, f. 5.

Jur.; Chile.

PLICATULA RAPA, B. & C., M. G. S. Fr., 2 s. v. 4, p. 16, Pl. 5, f. 8-10.

Id.

Hup., Gay, p. 293.

Jur.; Chile.

P. TORTA, Gabb, new sp.

Cret.; Peru.

ANOMIA PARVA, Gabb, Proc. Phil. Acad., 1860, p. 198, Pl. 3, f. 15.

Cret.; Chile.

A. PERUANA, Gabb, new sp.

Cret.; Peru.

PLACUNANOMIA LIMA, Gabb, new sp.

Cret.; Peru.

OSTREA ABRUPTA, d'Orb., A. Mer., p. 93, Pl. 21, f. 4-6.

Cret.; Col.

O. (*Exogyra*?) ATACAMENSIS, Phil., Atacama, p. 145, Pl. 1, f. 11-12.

Jur.? Chile.

O. CALLACTA, Con., Proc. Acad. N. S., Phil., 1875, p. 139, Pl. 22, f. 1.

O. sp. indet., Dana, Wilkes' Exped., Pl. 15, f. 7.

O. callacta, Gabb, present paper.

Jur.; Peru.

O. ENCARPIFERA, Hup., Gay's Chile, p. 286.

Jur.; Chile.

O. GREGARIA, Sby., M. Con., Pl. 111, f. 1-3.

Id. Bayle & Coq., M. G. S. Fr. 2 s., v. 4, p. 24.

Id. Hup., Gay's Chile, p. 285.

Id. Con., U. S. Astron. Exped., p. 283, Pl. 41, f. 1.

Jur.; Chile.

O. INOCERAMOIDES, d'Orb., A. Mer., p. 94.

Cret.; Col.

O. LARVIFORMIS, Gabb, new sp.

Cret.; Peru.

O. MARSHII, Sby., M. Con., Pl. 48.

Id. B. & Coq., M. G. Soc. Fr., p. 24, Pl. 5, f. 3.

Id. Hup., Gay's Chile, p. 284.

Jur.; Chile.

- O. PULLIGERA*, Goldf., Petr., v. 2, Pl. 72.
O. solitaria, Sby., M. Con., Pl. 468, f. 1.
O. pulligera, B. & C., M. G. Soc. Fr., 2 s., v. 4, p. 21, Pl. 5, f. 4-5.
Id. Hup., Gay, p. 283. Jur.; Chile.
O. RIVOTI, B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 24, Pl. 1, f. 7-8.
O. cymbium, B. & C. (not Lam.), loc. cit., Pl. 5, f. 6-7.
O. irregularis, Con. (not Munst.), Astr. Exped., p. 283, Pl. 42, f. 9.
O. Rivoti, Hup., Gay's Chile, p. 284. Jur.; Chile, Peru.
O. SANDALINA, Goldf., Petr., Pl. 79, f. 9.
Id. B. & Coq., Huppé. Jur.; Chile.
O. SANTIAGUENSIS, Hup., Gay's Chile, p. 288, Pl. 3, f. 3.
O. transitoria, on plate. Jur.; Chile.
GRYPHÆA ARCUATA, Lam., Syst. Nat., Pl. 6, p. 198.
Id. Goldf., Petr. p. 28, Pl. 84, f. 1.
G. incurva, Sby., M. Con., Pl. 112.
G. cymbium, Schlot., not Lam.
Id. Phil., Atacama, p. 144. Jurassic; Chile.
This probably includes also *G. Darwini*, Forbes, q. v.
G. CYMBIUM, Lam., Syst., vol. 6, p. 198.
Id. B. & C., M. G. S. Fr., 2 s., v. 4, p. 13, Pl. 4, f. 1.
Ostrea hemispherica, d'Orb., A. Mer., p. 106, Pl. 22, f. 3-4.
cymbium, Hup., Gay's Chile, p. 287. Lias.; Peru, Chile.
G. DARWINI, Fbs., Darwin's S. A., p. 266, Pl. 5, f. 7. "Secondary;" Jur.? Chile.
Probably = *G. arcuata*.
G. DILATATA, Sby., M. Con., Pl. 149, f. 2-3.
Ostrea id., Phil., Atacama, p. 144. Jur.; Chile.
"OSTREA (*Gryphæa*?) STRIATA," Phil., Atacama, p. 144, Pl. 1, f. 10. Jur.; Chile.
G. VESICULOIDES, Gabb, new sp. Cret.; Peru.
EXOGYRA LATERALIS, Nils. (sp.), Dub., Bull. G. Soc. Fr., vol. 8, p. 385.
Ostrea id., Nils., Pal. Suec., p. 29, Pl. 7, f. 10.
G. vomer, Mort., Syn. Cret., p. 54, Pl. 9, f. 5.
E. lateralis, Rath., Proc. Bost. N. H. Soc., v. 17, p. 243. Cret.; Brazil.
E. OBLONGA, Huppé (sp.).
Ostrea id., Hup., Gay's Chile, p. 284, Pl. 4, f. 2. Jur.; Chile.
E. PARASITICA, Gabb, Pal. Cal., v. 1, p. 205, Pl. 26, fig. 192; Pl. 31, f. 273.
Id. Gabb, present paper. Cret.; Peru
E. PLICATA, Lam. sp., Goldf., Petr., p. 37, Pl. 87, f. 5.
E. Boussingaultii, d'Orb., A. Mer., p. 91, Pl. 18, f. 20; Pl. 20, f. 8-9. Cret.; Peru, Col.
For further synonymy of this species, see Palæontology of California, v. 2, p. 275.
E. POLYGONA, Von Buch, Petr., p. 5, figs. 8-9.
Ostrea Couloni, B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 37, Pl. 7, f. 1-2.
Exogyra id., d'Orb. (not Deifr.), A. Mer., p. 93.
E. polygona, Gabb, present paper. Cret.; Colombia to Chile.

E. SQUAMATA, d'Orb., A. Mer., p. 92, Pl. 19, f. 12-15.

Id. d'Orb., Foss. Col., p. 58, Pl. 4, f. 12-15.

Ostrea subsquamata, d'Orb., Prod., v. 2, p. 108.

Cret.; Colombia.

HIPPURITES CHILENSIS, d'Orb., A. Mer., p. 107, Pl. 22, f. 16.

Cret.; Chile.

BRACHIOPODA.

TREBRATULA BICANALICULATA, Schlot., in Ziet., Pl. 40, f. 5.

Id. B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 31, Pl. 8, f. 17-19.

Id. Hup., Gay, p. 406.

Jur.; Chile.

T. DOMEYKANUS, B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 30, Pl. 8, f. 1-3.

Id. Hup., Gay, p. 403.

Jur.; Chile.

T. EMARGINATA, Sby., M. Con., Pl. 435, f. 5.

Id. B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 32, Pl. 8, f. 7-9.

Id. Hup., Gay, p. 406.

Jur.; Chile.

T. FICOIDES, B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 30, Pl. 8, f. 20-22.

Id. Hup., Gay, p. 405.

Jur.; Chile.

T. HAUSERI, Karst., Geog. Verh. N. Gren., p. 113, Pl. 6, f. 1.

Cret.; Col.

T. MERIDIONALIS, Con., U. S. Astron. Exped., p. 282, Pl. 42, f. 10.

Cret.? Chile.

T. ORNITHOCEPHALA, Sby., M. Con., Pl. 101.

T. Ignaciana, Fbs., Darwin's S. A., p. 63, Pl. 22, f. 14-15.

T. ornithocephala, B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 18, Pl. 8, f. 12-14.

Id. Hup., Gay, p. 404.

Jur.; Chile.

T. PEROVALIS, Sby., M. Con., Pl. 436, f. 2-3.

T. Inca, Fbs., Darwin's S. A., p. 268, Pl. 5, f. 19-20.

T. perovalis, B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 28, Pl. 8, f. 15-16.

Id. Hup., Gay, p. 403.

Jur.; Peru, Chile.

T. RAIMONDIANA, Gabb, new sp.

Jur.? Peru.

T. SUBEXCAVATA, Con., U. S. Astron. Exped., p. 282, Pl. 41, f. 4.

Cret.; Chile.

RHYNCHONELLA ANTONII, Gabb, new sp.

Jur.; Peru.

R. CONCINNA, Sby. (sp.), d'Orb., Prod., vol. 1, p. 315.

Terebratula id., Sby., M. Con., p. 189, Pl. 83, f. 6-7.

T. ænigma, d'Orb., A. Mer., p. 62, Pl. 22, f. 10-13.

T. concinna, B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 28, Pl. 8, f. 4-6.

Id. Hup., Gay's Chile, p. 405.

Jur.; Chile.

R. LACUNOSA, Schlot. (sp.), d'Orb., Prod., p. 375.

Terebratula id., Schlot., Petr., Pl. 1, f. 2.

R. id., B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 29, Pl. 8, f. 10-11.

Jur.; Chile.

R. SUBTETRAHEDRA, Con. (sp.).

Terebratula id., Con., U. S. Astron. Exped., p. 282, Pl. 42, f. 8.

Jur.; Chile.

R. TETRAHEDRA, Sby. (sp.), d'Orb., Prod.

T. id., Sby., M. Con., Pl. 83, f. 4.

T. id., B. & Coq., M. G. S. Fr., 2 s., v. 4, p. 17, Pl. 7, f. 9-10.

T. id., Hup., Gay's Chile, p. 404.

Jur.; Chile.

SPIRIFER TUMIDUS, Buch., M. G. S. Fr., vol. 4, Pl. 10, f. 20.

S. Chilensis, Fbs., Darwin's S. A., p. 267, Pl. 5, f. 15, 16.

S. linguiferoides, Fbs., *loc. cit.*, figs. 17-18.

S. tumidus, Hup., Gay's Chile, p. 407.

Lias.; Chile.

RADIATA.

ECHINODERMATA.

ECHINUS ANDINUS, Phil., Atacama, p. 146, Pl. 2, f. 11-13.

Jur.; Chile.

E. BIGRANULARIS, Lam., B. & Coq., M. G. S. Fr., v. 4, p. 32, Pl. 8, f. 35-36.

Jur.; Chile.

E. BOLIVARI, d'Orb., A. Mer., p. 95, Pl. 21, f. 11-13.

Id. d'Orb., Foss. Col., p. 61, Pl. 6, f. 11-13.

Id. Gabb, present paper.

Cret.; Col. & Peru.

E. DIADEMOIDES, B. & Coq., *loc. cit.*, p. 33, Pl. 8, f. 33, 34.

Jur.; Chile.

CIDARITES OVATA, Phil., Atacama, p. 146, Pl. 1, f. 13-14.

Jur.; Chile.

PYGURUS COLUMBIANUS, d'Orb., Prod., v. 2, p. 109.

Laganum id., d'Orb., A. Mer., p. 95, Pl. 21, f. 10.

Id. d'Orb., Foss. Col., p. 60, Pl. 6, f. 10.

Cret.; Col.

BOTRIOPYGUS ELEVATUS, Gabb, new sp.

Cret.; Peru.

B. COMPRESSUS, Gabb, new sp.

Cret.; Peru.

DISCOIDEA EXCENTRICA, d'Orb., A. Mer., p. 94, Pl. 21, f. 7-9.

Id. d'Orb., Foss. Col., p. 60, Pl. 6, f. 7-9.

Cret.; Col.

D. NUMISMALIS, Gabb, new sp.

Cret.; Peru.

ENNALASTER PERUANA; Gabb, new sp.

Cret.; Peru.

PERIASTER AUSTRALIS, Gabb, new sp.

Cret.; Peru.

MICRASTER CHILENSIS, Phil., Atacama, p. 147, Pl. 2, f. 8-10.

Jur.; Chile.

? SPATANGUS COLOMBIANUS, Lea, Tr. Amer. P. Soc., 2 s., v. 7, p. 257, Pl. 9, f. 11.

Cret.; Col.

FORAMENIFERA.

CYCLOPÆA RUMICHACÆ, Karst., Geog. Verh. N. Gren., p. 113, Pl. 6, f. 2.

Cret.; Col.

ORTHOCERINA EWALDI, Karst., *loc. cit.*, p. 114, Pl. 6, f. 3.

Cret.; Col.

PLANULINA ZAPATOCENSIS, Karst., *loc. cit.*, p. 114, Pl. 6, f. 4.

Cret.; Col.

ROBULINA SOGAMOZÆ, Karst., *loc. cit.*, p. 114, Pl. 6, f. 5.

Cret.; Col.

ORBITULITES LENTICULARIS, Karst., *loc. cit.*, p. 114, Pl. 6, f. 6.

Cret.; Col.

CAINOZOIC.

CRUSTACEA.

CIRRIPEDIA.

BALANUS LÆVIS, Brug., Enc. Meth., Pl. 164, f. 1.

B. discors, Ranzoni, Mem. di Storia Nat. 1820, Pl. 3, f. 9-13.

B. Coquimbensis, Sby., Darwin's S. A., p. 264, Pl. 2, f. 7.

B. lævis, Darwin, Monog. Cirr., p. 227, Pl. 4, f. 2.

Tert.; Chile & Patagonia.

B. PSITTACUS, Molina (sp.), King & Brod., Zool. Jour., v. 5, p. 332.

Lepas id., Molina, N. H. Chile, v. 1, p. 223.

B. picos, Lesson, Voy. Coquille.

B. tintinabulum (var. *C.*), Ranzani, Mem. Storia N., 1820, Pl. 3, f. 1-3.

B. cylindraceus, Lam., Chenu Conch. Ill., Pl. 4, f. 17; Pl. 5, f. 7.

Not id., Lam., A. S. Vert.

B. psittaceus, Darwin, Monog. Cirr., p. 206, Pl. 2, f. 3.

Tert.; Chile, Peru.

B. VARIANS, Sby., Darwin's S. A., p. 264, Pl. 2, f. 4-6.

Id. Darwin, Monog. Cirr., p. 298, Pl. 8, f. 9.

Tert.; Chile, Peru.

MOLLUSCA.

GASTEROPODA

TROPHON PATAGONICUS, Sby. (sp.).

Fusus id., Sby., Darwin's S. A., p. 259, Pl. 4, f. 60.

Tert.; Patagonia.

? *FUSUS PYRULIFORMIS*, Sby., Darwin's S. A., p. 258, Pl. 4, f. 56.

Tert.; Chile.

Not a true Fusus.

F. PAYTENSIS, Gabb, J. Conch., 1869, p. 25.

Id. Gabb, present paper.

Tert.; Peru.

FUSUS (*Volema*) *SUBREGULARIS*, d'Orb. (sp.).

F.? *regularis*, Sby., Darwin's S. A., p. 258, Pl. 4, f. 55.

Not id., Desh.

F. subregularis, d'Orb., Prod., v. 3, p. 69, No. 1262.

F. striato-nodosus, Hup., Gay's Chile, p. 174, Pl. 2, f. 5.

Tert.; Chile.

PRISCOFUSUS SUBREFLEXUS, Sby. (sp.).

Fusus id., Sby., Darwin's S. A., p. 259, Pl. 4, f. 57.

Tert.; Chile.

NEPTUNEA CLATHRATA, Huppé (sp.).

Fusus id., Hup., Gay, p. 174, Pl. 2, f. 4.

Tert.; Chile.

N. CLERYANA, d'Orb. (sp.).

Fusus id., d'Orb., A. Mer., p. 117, Pl. 12, f. 6-9.

Id. Hup., Gay's Chile, p. 172.

Tert.; Chile.

Rémond has referred this species to the Cretaceous, but the other authors agree in calling it Tertiary.

N. NOACHINA, Sby. (sp.).

Fusus Noachinus, Sby., Darwin's S. A., p. 259, Pl. 4, f. 58, 59.

Tert.; Pat.

N. ORBIGNYI, Hup. (sp.).

Fusus id., Huppé, Gay's Chile, p. 175, Pl. 3, f. 5.

F. sulcatus on plate.

Tert.; Chile.

N. PETITIANA, d'Orb. (sp.).

Fusus id., d'Orb., A. Mer., p. 118, Pl. 12, f. 10.

Tert.; Chile.

CASSIDULA ECHINULATA, Hup. (sp.).

Fusus id., Hup. (sp.), Gay's Chile, p. 173, Pl. 2, f. 3.

Tert.; Chile.

CLAVELLA SOLIDA, Nelson, Tr. Conn. Acad., v. 2, p. 199.

Tert.; Peru.

- PLEUROTOMA TURBINELLOIDES, Sby., Darwin's S. A., p. 258, Pl. 4, f. 53. Tert.; Chile.
 Evidently not a *Pleurotoma* (or better *Turris*) in the restricted sense, but we have not sufficient information to refer the species to its proper genus.
- SURCULA DISCORS, Sby. (sp.).
Pleurotoma id., Sby., Darwin, p. 258, Pl. 4, f. 54. Tert.; Chile.
 MANGELIA LANCEOLATA, Hup. (sp.).
Pleurotoma id., Hup., Gay's Chile, p. 117, Pl. 3, f. 7. Tert.; Chile.
 TRITONIUM ARMATUM, Hup. (sp.).
Triton id., Hup., Gay's Chile, p. 182, Pl. 3, f. 1. Tert.; Chile.
 T. PERNODOSUM, Gabb, present paper. Tert.; Peru.
 T. VERRUCULOSUM, Sby. (sp.).
Triton id., Sby., Darwin's S. A., p. 260, Pl. 4, f. 63. Tert.; Chile.
 T. (*Ranularia*) LEUCOSTOMOIDES, Sby.
Triton id., Sby., Darwin, p. 260, Pl. 4, f. 64. Tert.; Chile.
 T. (*Argobuccinum*) SCABER, Brod.
Triton id., Brod., Zool. Jour., 1822, p. 348.
Id. d'Orb., A. Mer., p. 158. Quart.; Bolivia.
 T. (A.) ZORRITENSE, Nelson.
Argobuccinum id., N., Tr. Conn. Acad., v. 2, p. 198, Pl. 7, f. 1-2. Tert.; Peru.
 BUCCINANOPS COCHLIDIUM, Chenu (sp.), d'Orb., Moll. A. Mer., p. 354, Pl. 61, f. 25.
Id. d'Orb., Foss. A. Mer., p. 157.
Buccinum id., Chenu, Conch. Cab., v. 11, p. 275, Pl. 209, f. 2053. Quart.; Pat.
 B. GLOBULOSUM, Kien. (sp.), d'Orb., Moll. A. Mer., p. 355, Pl. 61, f. 24.
Id. d'Orb., Foss. A. Mer., p. 157.
Buccinum id., Kiener, Buccinum, p. 12, Pl. 10, f. 33. Quart.; Peru, Arg. Rep.
 PURPURA CASSIDIFORMIS, Blainv., M. sur Purp., p. 42.
Id. Hup., Gay's Chile, p. 188. Quart.; Chile.
 P. CHOCOLATA, Ducl., A. Sc. Nat., v. 26, Pl. 2, f. 7.
Id. d'Orb., Foss. A. Mer., p. 157. Quart.; Bol.
Id. Gabb, Am. Jour. Conch., 1869, p. 26. Tert.; Peru.
 CONCHOLEPAS PERUVIANUS, Lam., A. S. V.
Purpura concholepas, d'Orb., Moll. A. Mer., p. 360, Pl. 61, f. 5-7.
Id. d'Orb., Foss. A. Mer., p. 158.
Id. Hup., Gay, p. 201. Quart.; Chile; Bol.
 C. KIENERI, Hup., Gay, p. 203, Pl. 3, f. 4. Quart.; Chile.
 GASTRIDIDIUM CEPA, Sby., Darwin, p. 261, Pl. 4, f. 68-69. Tert.; Chile.
 MONOCERAS AMBIGUUS, Sby., Darwin, p. 261, Pl. 4, f. 66-67. Tert.; Chile.
 M. BLAINVILLEI, d'Orb., A. Mer., p. 116, Pl. 6, f. 18-19.
Id. Hup., Gay, p. 197. Tert.; Peru? Chile.
 M. GIGANTEUM, Less., Voy. Coq., p. 405, Pl. 11, f. 4.
Id. Hup., Gay, p. 198. Tert.; Chile.
 M. LABIALE, Hup., Gay, p. 199, Pl. 3, f. 3. Tert.; Chile.
 M. OPIMUM, Hup., Gay, p. 200, Pl. 2, f. 6. Tert.; Chile.

- M. UNICORNE*, Brug. (sp.).
Buccinum id., Brug., Enc. Meth., t. 396, f. 2.
M. crassilabrum, Lam., A. S. V.
M. unicorn, Gray, etc., Hup., Gay's Chile, p. 194. Quart.; Chile.
CUMA ALTERNATA, Nelson, Tr. Conn. Acad., v. 2, p. 198, Pl. 7, f. 3-4. Tert.; Peru.
?OLIVA SERENA, d'Orb., A. Mer., p. 116, Pl. 14, f. 9. Tert.; Chile.
PORPHYRIA PERUVIANA, Lam. (sp.), Auct.
Oliva id., Lam., A. S. V.
Id. Hup., Gay's Chile, p. 216. Quart.; Chile.
OLIVELLA DIMIDIATA, Sby. (sp.).
Oliva id., Sby., Darwin, p. 263, Pl. 4, f. 76-77. Tert.; Chile.
O. SIMPLEX, Hup. (sp.).
Oliva id., Hup., Gay's Chile, p. 217, Pl. 3, f. 9. Tert.; Chile.
OLIVANCILLARIA AURICULARIS, Lam. (sp.), d'Orb., Moll. A. M., p. 421, Pl. 59, f. 20-22.
Id. d'Orb., Foss. A. Mer., p. 156.
Oliva id., Lam., A. S. V., v. 7, p. 434. Quart.; Pat.
O. BRAZILIENSIS, Chenu (sp.), d'Orb., M. A. Mer., p. 420.
Id. d'Orb., Foss. A. Mer., p. 155.
Oliva id., Chenu, Conch. Cab., p. 130, Pl. 147, f. 1367-1370. Quart.; Pat.
O. TUMORIFERA, Hup. (sp.).
Oliva id., Hup., Gay, p. 217, Pl. 3, f. 8. Tert.; Chile.
FASCIOLARIA TRIPPLICATA, Sby. (sp.).
Voluta id., Sby., Darwin, p. 262, Pl. 4, f. 74.
V. subtriplicata, d'Orb., Prod., v. 3, p. 53. Tert.; Chile.
CYMBIOLA ALTA, Sby. (sp.).
Voluta id., Sby., Darwin, p. 262, Pl. 4, f. 75. Tert.; Chile, Pat.
C. BRAZILIANA, Solander (sp.), H. & R. Ad. Genera.
Voluta id., Sol., Cat. Portl. Mus., No. 3958.
Id. Lam., A. S. V., v. 7, p. 355.
Id. d'Orb., A. Mer., p. 156. Quart.; Pat., Arg. Rep.
VOLUTELLA ANGULATA, Sw. (sp.)?
Voluta id., Swains., Donovan, Pl. 1.
Volutella id., d'Orb., A. Mer., Moll., p. 423, Pl. 60, f. 1-3.
Id. d'Orb., Foss. A. Mer., p. 156. Quart.; Pat.
SCAPHELLA TUBERCULATA, Wood (sp.).
Voluta id., Wood, Ind. Supp., No. 22.
Id. d'Orb., A. Mer., p. 157. Quart.; Pat.
VOLUTIDERMA PLICIFERA, Gabb, present paper.
Volutilithes id., Gabb., Am. Jour. Conch., 1869, p. 28. Tert.; Peru.
MARGINELLA INCRASSATA, Nelson, Tr. Conn. Acad., v. 2, p. 197, Pl. 6, f. 5-6. Tert.; Peru.
STROMBINA LANCEOLATA, Sby. (sp.), Chr., Br. Assn. Rep., 1856.
Id. Nelson, Tr. Conn. Acad., v. 2, p. 197.
Columbella id., Sby., Pr. Zool. Soc., 1832, p. 116. Tert.; Peru.

- GALEODEA MONILIFERA, Sby. (sp.).
Cassis id., Sby., Darwin, p. 260, Pl. 4, f. 65. Tert.; Chile.
- G. TUBERCULIFERA, Hup. (sp.).
Cassidaria id., Hup., Gay's Chile, p. 209, Pl. 3, f. 2. Tert.; Chile.
- FICUS DISTANS, Sby. (sp.).
Pyrula id., Sby., Darwin, p. 259, Pl. 4, f. 61. Tert.; Chile.
- EUSPIRA ORTONI, Gabb, present paper.
Ampullina id., G., Am. Jour. Conch., 1869, p. 27. Tert.; Peru.
- LUNATIA ISABELLINA, d'Orb. (sp.).
Natica id., d'Orb., A. Mer., Moll., p. 402, Pl. 76, f. 12-13.
Id. d'Orb., Foss. A. M., p. 154. Quart.; Arg. Rep.
- L. LIMBATA, d'Orb. (sp.).
Natica id., d'Orb., Moll. A. Mer., p. 402, Pl. 57, f. 7-9.
Id. d'Orb., Foss. A. M., p. 154. Quart.; Pat.
- NEVERITA PACHYSTOMA, Hup. (sp.).
Natica id., Hup., Gay's Chile, p. 223, Pl. 1, f. 6. Tert.; Chile.
- UBER SUBANGULATA, Nelson (sp.).
Polinices id., Nelson, Tr. Conn. Acad., v. 2, p. 195, Pl. 6, f. 4, 12-13. Tert.; Peru.
- SIGARETUS SUBGLOBOSUS, Sby., Darwin, p. 254, Pl. 3, f. 36-37. Tert.; Chile.
- S. ELEGANS, Hup., Gay, p. 226, Pl. 1, f. 5. Tert.; Chile.
- SCALARIA (*Clathrus*) ELEGANS, d'Orb.
S. elegans, d'Orb., Moll. A. Mer., p. 389, Pl. 54, f. 1-3.
Id. d'Orb., Foss. *id.*, p. 154. Quart.; Pat., Arg. Rep.
- S. (*C.*) RUGULOSA, Sby.
S. rugulosa, Sby., Darwin, p. 255, Pl. 3, f. 42-43. Tert.; Pat.
- TURBONILLA MINUSCULA, Gabb, J. Conch., 1868, p. 197, Pl. 16, f. 1.
Id. Gabb, present paper. Tert.; Peru.
- TEREBRA COSTELLATA, Sby., Darwin, p. 262, Pl. 4, f. 70-71. Tert.; Chile.
- T. (*Myurella*) TUBEROSA, Nelson.
M. tuberosa, Nelson, Tr. Conn. Acad., v. 2, p. 193. Tert.; Peru.
- T. UNDULIFERA, Sby., Darwin, p. 262, Pl. 4, f. 72-73. Tert.; Chile.
- ARCHITECTONICA COLLARIS, Sby. (sp.).
Trochus id., Sby., Darwin, p. 256, Pl. 3, f. 44-45. Tert.; Chile.
- A. LÆVIS, Sby., *id.*, p. 256, Pl. 3, f. 46-47. Tert.; Chile.
- These two species, belonging to the same genus or subgenus, differ from the typical form of *Architectonica* in the absence of the characteristic sculpture; they probably indicate a new subgenus.
- A. SEXLINEARIS, Nelson (sp.).
Solarium id., N., Tr. Conn. Acad., v. 2, p. 194, Pl. 6, f. 11. Tert.; Peru.
- RIMELLA GAUDICHAUDI, d'Orb. (sp.).
Rostellaria id., d'Orb., A. Mer., p. 116, Pl. 14, f. 6-8. Tert.; Peru.
- CANCELLARIA BRADLEYI, Nelson, Tr. Conn. Acad., v. 2, p. 192, Pl. 6, fig. 8-9. Tert.; Peru.
- C. LARKINII, N., *loc. cit.*, p. 192, Pl. 6, f. 7. Tert.; Peru.

- C. (Aphera) PERUANA*, N., *loc. cit.*, p. 190, Pl. 6, f. 3. Tert.; Peru.
C. SPATIOSA, N., *loc. cit.*, p. 191. Tert.; Peru.
C. TRIANGULARIS, Nelson, *loc. cit.*, p. 191, Pl. 6, f. 10. Tert.; Peru.
TRICHOTROPIS (Iphinoe) ORNATA, Sby. (sp.).
Struthiolaria ornata, Sby., Darwin, p. 260, Pl. 4, fig. 62. Tert.; Pat.
CERITHIUM LÆVIUSCULUM, Gabb, J. Conch., 1869, p. 27.
Id. Gabb, present paper. Tert.; Peru.
PLANORBIS PEBASANA, Con., Proc. Acad. Nat. Sci., Phila., v. 26, p. 30. Tert.; Brazil.
PALUDINESTRA AUSTRALIS, d'Orb., Moll. A. Mer., p. 384, Pl. 48, f. 4-6.
Id. d'Orb., Foss. A. Mer., p. 153. Quart.; Patagonia.
LIOSOMA CURTA, Con., P. Acad. Nat. Sci., Phila., v. 26, p. 31, Pl. 1, f. 8. Tert.; Brazil.
ISÆA LINTEA, Con., Jour. Conch., v. 6, p. 193, Pl. 10, f. 6. Tert.; Brazil.
I. ORTONI, Gabb (sp.), Con., J. Conch., v. 6, p. 193, Pl. 10, f. 10-13; Pl. 11, f. 8.
Mesalia id., Gabb, J. Conch., v. 4, p. 198, Pl. 16, f. 3. Tert.; Brazil.
HEMISINUS STEEREI, Con., P. Acad. Nat. Sci., Phila., v. 26, p. 32, Pl. 1, f. 14. Tert.; Brazil.
H. SULCATUS, Con., J. Conch., v. 6, p. 194, Pl. 10, f. 2. Tert.; Brazil.
DYRIS GRACILIS, Con., J. Conch., p. 195, Pl. 10, f. 8; Pl. 11, f. 7. Tert.; Brazil.
EBORA (Neseis) BELLA, Con., J. C., v. 6, p. 184, Pl. 10, f. 17.
Fossar bella, Woodw., A. M. N. H., 1871, p. 102, Pl. 5, f. 3. Tert.; Brazil.
E. CRASSILABRA, Con., J. C., v. 6, p. 194, Pl. 10, f. 14.
Id. Con., P. Acad. Nat. Sci., Phila., v. 26, p. 32, Pl. 1, f. 9. Tert.; Brazil.
LITTORINA LAQUEATA, Gabb, J. Conch., 1869, p. 28.
Id. Gabb, present paper. Tert.; Peru.
TURRITELLA AFFINIS, Hup., Gay, p. 155, Pl. 2, f. 7. Quart.; Pat.
T. AMBULACRUM, Sby., Darwin, p. 257, Pl. 3, f. 49.
T. suturalis, Sby., *loc. cit.*, p. 257, Pl. 3, f. 50. Tert.; Pat.
T. BIFASCIATA, Nelson, Tr. Conn. Acad., v. 2, p. 189. Tert.; Peru.
T. CINGULATA, Sby.
Id. Hup., Gay's Chile, p. 154. Quart.; Chile.
T. COCHLEIFORMIS, Gabb, J. Conch., 1869, p. 29. Tert.; Peru.
T. PATAGONICA, Sby., Darwin, p. 256, Pl. 3, f. 48.
T. Chilensis, Sby., *loc. cit.*, p. 257, Pl. 4, f. 1.
Cerithium cælatum, Con., P. Acad. Nat. Sci., Phila., 1846, p. 19, Pl. 1, f. 19. Tert.; Pat.; Chile.
T. PLANA, Nelson, Tr. Conn. Acad., v. 2, p. 188. Tert.; Peru.
T. SUTURALIS, Nelson, *id.*, p. 188. Tert.; Peru.
CRUCIBULUM INERME, Nelson, *id.*, p. 188. Tert.; Peru.
TROCHITA TROCHIFORMIS, Chemn. (sp.).
Patella id., Chemn., Conch. Cab., p. 355, Pl. 168, f. 1626, 1627.
Trochus radians, Lam., A. S. V., v. 7, p. 11.
Calyptræa Araucana, Less., Voy. Coquille, p. 386.
C. trochiformis, d'Orb., Moll. A. Mer., p. 461, p. 59, f. 3.
Infundibulum id., d'Orb., Foss. A. M., p. 158.
Trochita radians, H. & A. Ad. Gen. Moll.

- C. trachiformis*, Hup., Gay's Chile, p. 232. Quart.; Bol., Chile.
- CRYPTA DILATATA, Lam. (sp.), H. & A. Ad., Gen. Moll.
- Crepidula id.*, Lam., A. S. V., v. 6, p. 25.
- Id.* d'Orb., A. Mer., p. 159.
- Calyptæa id.*, Hup., Gay's Chile, p. 233. Quart.; Chile.
- C. GREGARIA, Sby. (sp.).
- Crepidula id.*, Sby., Darwin, p. 254, Pl. 3, f. 34. Tert.; Pat.
- NERITINA ORTONI, Con., J. Conch., v. 6, p. 195, Pl. 10, f. 11.
- N. pupa*, Gabb (not Lin.), J. Conch., v. 4, p. 197, Pl. 16, f. 2. Tert.; Brazil.
- ?TROCHUS ROUAULTII, Hup., Gay, p. 148. Quart.; Chile.
- MONODONTA PATAGONICA, d'Orb. (sp.).
- Trochus id.*, d'Orb., Moll. A. Mer., p. 408, Pl. 55, f. 1-4. Quart.; A. Rep., Pat.
- CHLOROSTOMA LUCTUOSUM, d'Orb. (sp.), H. & A. Ad., Genera, p. 428.
- Trochus id.*, d'Orb., Moll. A. Mer., p. 409, Pl. 76, f. 16-19.
- Id.* d'Orb., Foss. A. Mer., p. 155. Quart.; Bol.
- CALLOPOMA LINEATUM, Nelson, Tr. Conn. Acad., v. 2, p. 186, Pl. 6, f. 2. Tert.; Peru.
- C. NODULIFERUM, Nels., *loc. cit.*, p. 187, Pl. 6, f. 1. Tert.; Peru.
- DENTALIUM GIGANTEUM, Sby., Darwin, p. 263, Pl. 2, f. 1.
- D. corrugatum*, Hup., Gay, p. 276, Pl. 2, f. 8. Tert.; Chile.
- D. INTERMEDIUM, Hup., Gay, p. 276, Pl. 2, f. 9. Tert.; Chile.
- D. MAGUS, Sby., Darwin, p. 263, Pl. 2, f. 3. Tert.; Chile.
- D. SULCOSUM, Sby., *Id.*, p. 263, Pl. 2, f. 2. Tert.; Chile.
- FISSURELLA CRASSA, Lam., A. S. V., v. 6, p. 11.
- Id.* Hup., Gay, p. 240.
- Id.* d'Orb., A. Mer., p. 159. Quart.; Chile, Bol.
- SIPHONARIA LESSONI, Blainv. Malac., Pl. 44, f. 2.
- Id.* d'Orb., A. Mer., p. 159. Quart.; Arg. Rep.
- PATELLA MEXICANA, Brod. & Sby., Zool. Jour., v. 4, p. 369.
- Id.* Rve., Icones, Sp. 1. Tert.; Peru, (Payta).
- I have a remarkably fine example among the Raimondi fossils.
- ACMÆA SUBRUGOSA, d'Orb., Moll. A. Mer., p. 497.
- Id.* d'Orb., Foss. A. Mer., p. 160. Quart.; Arg. Rep.
- CHITON TUBERCULIFERUS, Sby., Tank. Cat.
- C. spiniferus*, Fremby, Zool. Jour., p. 196, Pl. 16, f. 1.
- C. tuberculiferus*, d'Orb., A. Mer., p. 159. Quart.; Bo.
- CHILINA ANTIQUATA, d'Orb., A. Mer., p. 114. Tert.; Pat.
- BULLA AMBIGUA, d'Orb., A. Mer., p. 113, Pl. 12, f. 1-3.
- Id.* Hup., Gay's Chile, p. 86. Tert.; Chile.
- B. COSMOPHILA, Sby., Darwin, p. 254, Pl. 3, f. 35. Tert.; Chile.
- BULIMUS LINTEUS, Con., J. Conch., v. 6, p. 195, Pl. 10, f. 9. Tert.; Brazil.
- LIRIS LAQUEATA, Con., *loc. cit.*, p. 194, Pl. 10, f. 3. Tert.; Brazil.
- CYCLOCHEILA PEBASANA, Con., P. Acad. Nat. Sci., Phila., v. 26, p. 32, Pl. 1, f. 17. Tert.; Brazil.
- CIRROBASIS VENUSTA, Con., *loc. cit.*, p. 31, Pl. 1, f. 15. Tert.; Brazil.

- TOXOSOMA EBOREA, Con., *loc. cit.*, p. 31, Pl. 1, f. 7. Tert.; Brazil.
 ?PACHYTOMA TERTIANA, Con., *loc. cit.*, p. 31, Pl. 1, f. 11. Tert.; Brazil.

LAMELLIBRANCHIATA.

- DACTYLINA CHILOENSIS, Molina (sp.).
Pholas id., Molina, Hist. Chile, p. 179.
Id. Hup., Gay's Chile, p. 381, Pl. 6, f. 3.
Dactylina id., Gabb, J. Conch., 1869, p. 29. Tert.; Chile, Peru.
 SOLECURTUS HANETIANA, d'Orb.
Solenocurtus id., d'Orb., A. Mer., p. 124, Pl. 15, f. 1-2.
Solecurtus id., Hup., Gay's Chile, p. 368. Tert.; Chile.
 CORBULA BRADLYI, Nelson, Tr. C. Acad., v. 2, p. 200. Tert.; Peru.
 AZARA LABIATA, Matton (sp.), d'Orb., A. Mer., p. 161.
Mya id., Matton. Quart.; Arg. Rep.
 PACHYDON ALATUS, Con., J. Conch., v. 6, p. 197, Pl. 11, f. 1.
Id. Con., P. Acad. Nat. Sci., Phila., v. 26, p. 28, Pl. 1, f. 4, 18. Tert.; Brazil
 P. CARINATUS, Con., J. Conch., v. 6, p. 196, Pl. 10, f. 7.
Anisothyris id., Woodw., Ann. M. N. H., 1871, p. 108, Pl. 5, f. 6. Tert.; Brazil.
 P. CUNEATUS, Con., J. Conch., v. 6, p. 179, Pl. 10, f. 12.
Anisothyris id., Woodw., *loc. cit.*, p. 107, Pl. 5, f. 8-a-b.
P. id., Con., Proc. Acad. Nat. Sci., Phila., v. 26, p. 28, Pl. 1, f. 3. Tert.; Brazil.
 P. (*Anisorhyncus*) CUNEIFORMIS, Con., *loc. cit.*, p. 28, Pl. 1, f. 19. Tert.; Brazil.
 P. (*A.?*) DISPAR, Con., *loc. cit.*, p. 27, Pl. 1, f. 1. Tert.; Brazil.
 P. ERECTUS, Con., J. Conch., v. 6, p. 197, Pl. 10, f. 16.
Anisothyris id., Woodw., A. M. N. H., 1871, p. 107, Pl. 5, f. 9-a-b.
P. id., Con., Proc. Acad. Nat. Sci., Phila., v. 26, p. 28. Tert.; Brazil.
 P. LEDÆFORMIS, Dall (sp.).
Corbula (Anisothyris?) id., Dall, J. Conch., v. 8, p. 92, Pl. 16, f. 14-15. Tert.; Brazil.
 P. OBLIQUUS, Gabb, Jour. Conch., v. 4, p. 199, Pl. 16, f. 5.
Id. Con., J. Conch., v. 6, p. 197, Pl. 10, f. 15.
Anisothyris id., Woodw., A. M. N. H., 1871, p. 106, Pl. 5, f. 5-a-b. Tert.; Brazil.
 P. OVATUS, Con., J. Conch., v. 6, p. 197, Pl. 10, f. 4.
Anisothyris id., Woodw., A. M. N. H., 1871, p. 106. Tert.; Brazil.
 P. TENUIS,* Gabb, J. Conch., v. 4, p. 199, Pl. 16, f. 6.
P. id., Con., J. Conch., v. 6, p. 196, Pl. 10, f. 1.
Anisothyris Hauxwelli, Woodw., A. M. N. H., 1871, p. 105, Pl. 5, f. 7-a-d.
Tellina Amazonensis, Gabb, J. Conch., v. 4, p. 198, Pl. 16, f. 4. Tert.; Brazil.

* In insisting on the use of this name, I am sustained by all the rules of scientific nomenclature. Otherwise I should be very loath to raise a question over so paltry a matter as the privilege of claiming a genus or species. Mr. Conrad proposed *Anisothyris* because, as he says, he was requested to do so, *Pachydon* being considered objectionable; at the same time he described all of his own species under the old generic name, and subsequently retracted *Anisothyris* and described several more, also, as *Pachydon*. Woodward arbitrarily

?HOMOMYA RUGATA, Sby. (sp.).	
<i>Macra?</i> <i>id.</i> , Sby, Darwin, p. 249, Pl. 2, f. 8.	Tert.; Pat.
MACTRA COLCHAGUANA, Hup., Gay, p. 349.	Tert.; Chile.
M. ZORRITENSIS, Nelson, Tr. Conn. Acad., v. 2, p. 201.	Tert.; Peru.
STANDELLA AUCA, d'Orb. (sp.).	
<i>Macra id.</i> , d'Orb., A. Mer., p. 125, Pl. 14, f. 19-20.	
<i>Id.</i> Hup., Gay's Chile, p. 349.	Tert.; Chile.
?HEMIMACTRA DARWINII, Sby. (sp.).	
<i>Macra id.</i> , Sby., Darwin, p. 249, Pl. 2, f. 9.	Tert.; Pat.
LUTRARIA PLICATELLA, Lam., A. S. V., v. 5, p. 470.	
<i>Id.</i> d'Orb., A. Mer., p. 161.	Quart.; Pat.
RÆTA GIBBOSA, Gabb, J. Conch., v. 4, p. 30.	
<i>Id.</i> Gabb, present paper.	Tert.; Peru.
OSTOMYA PAPYRIA, Con., Proc. Acad. Nat. Sci., Phila., v. 26, p. 30, Pl. 1, f. 6.	Tert.; Brazil.
PERONÆA PETITIANA, d'Orb. (sp.).	
<i>Tellina id.</i> , d'Orb., Moll. A. Mer., p. 537, Pl. 81, f. 26-27.	
<i>Tellinides?</i> <i>oblonga</i> , Sby., Darwin, p. 250, Pl. 2, f. 12.	Tert.; Chile.
MACOMA HUAFFOENSIS, Con. (sp.).	
<i>Tellina id.</i> , Con., Proc. Acad. Nat. Sci., Phila., 1846, p. 20, Pl. 1, f. 20.	Tert.; Pat.
AMPHIDESMA BREVIROSTRUM, Hup., Gay, p. 361, Pl. 6, f. 1.	Tert.; Chile.
STRIGILLA PRORA, Hanley (sp.).	
<i>Tellina id.</i> , Hanley, Zool. Proc., 1844.	
<i>Strigilla id.</i> , Gabb, J. Conch., 1869, p. 30.	Tert.; Peru.
MESODESMA DONACINA, Rve., Conch., Pl. 45, f. 1.	
<i>Donacilla Chilensis</i> , d'Orb., Moll. A. Mer., p. 530.	Quart.; Chile.
VENUS BAYLII, Hup., Gay, p. 340.	Tert.; Chile.
?V. CHILENSIS, d'Orb., A. Mer., p. 124, Pl. 13, f. 12-13.	
<i>Lucina id.</i> , d'Orb., on plate.	
<i>V. id.</i> , Hup., Gay's Chile, p. 342.	Tert.; Chile.
?V. CLERYANA, d'Orb., A. Mer., p. 123, Pl. 13, f. 7-8.	
<i>Id.</i> Hup., Gay, p. 341.	Tert.; Chile.
?V. COQUANDI, Hup., Gay, p. 340.	Tert.; Chile.
V. DOMBEI, Lam., A. S. V., v. 5, p. 590.	

brushes aside both generic and specific name, saying, in the former case, "the objection to *Pachydon* is too obvious to need any further delay in condemning it." Mr. Conrad's objection is that its derivation is the same as *Pachyodon* (= ? *Paxyodon* Schum.) Woodward's objection to the specific name—*tenuis*—is that his specimens were *not* thin; mine were; and there is no rule of nomenclature that authorizes one writer to change a name once given to a species, by another, unless it is pre-occupied. As to the name *Pachydon*, there are numerous precedents for the elision of an uneuphonic letter in generic names; and if, at the worst, the word should have no meaning; if it is a "nonsense name," there are not wanting precedents—and eminent ones. Mr. Woodward would not presume to amend Adanson and others! The etymology of *Pachydon* is presumed to be the same as that of Schumacher's *Paxyodon*, but there can be no possible chance of confusion between the two words, either for the eye or ear. I was not ignorant of the existence of this name when I proposed my own; nor yet of Stutchbury's *Pachyodon*, which is synonymous with *Thalassides* of Berger.

- V. DOMBEI, d'Orb., A. Mer., p. 160. Quart.; Bol.
- V. HANETIANA, d'Orb., A. Mer., p. 123, Pl. 13, f. 3-4.
- Id. Hup., Gay, p. 341. Tert.; Chile.
- V. OPACA, Brod., Zool. Proc.
- Id. d'Orb., A. Mer., p. 160. Quart.; Bol.
- ?V. PETITIANA, d'Orb., A. Mer., p. 123, Pl. 13, f. 9-11.
- Id. Hup., Gay's Chile, p. 342. Tert.; Chile.
- ?V. PULVINATA, Hup., Gay, p. 343. Tert.; Chile.
- CHIONE LENTICULARIS, Sby. (sp.), H. & A. Ad., Gen.
- Venus id., Sby., Proc. Zool. Soc., 1835, p. 42.
- Id. Hup., Gay, p. 336, Pl. 6, f. 1. Quart.; Chile.
- C. MERIDIONALIS, Sby. (sp.).
- Venus id., Sby., Darwin, p. 250, Pl. 2, f. 13. Tert.; Chile; Pat.
- C. MUNSTERI, d'Orb. (sp.).
- Venus id., d'Orb., A. Mer., p. 121, Pl. 7, f. 10-11. Tert.; Pat.; Arg. Rep.
- ?C. PATAGONICA, d'Orb. (sp.).
- Venus id., d'Orb., A. Mer., p. 160. Quart.; Pet.
- C. SUBALBICANS, Hup. (sp.).
- Venus id., Hup., Gay's Chile, p. 339. Tert.; Chile.
- C. VARIABILIS, Nelson, Tr. Conn. Acad., v. 2, p. 202. Tert.; Peru.
- CALLISTA ROUAULTII, Hup. (sp.).
- Venus id., Hup., Gay's Chile, p. 339. Tert.; Chile.
- C. SULCULOSA, Sby. (sp.).
- Cytherea id., Sby., Darwin, p. 250, Pl. 2, f. 14. Tert.; Chile.
- DOSINIA GRANDIS, Nelson, Tr. Conn. Acad., v. 2, p. 201. Tert.; Peru.
- PETRICOLA CHILOENSIS, Phil., Wiegmann's Archiv., No. 8.
- Id. Hup., Gay, p. 345. Quart.; Chile.
- CARDIUM (*Cerastoderma*) MULTIRADIATUM, Sby.
- C. multiradiatum, Sby., Darwin, p. 251, Pl. 2, f. 16. Tert.; Chile.
- Not id. Gabb, Cret. U. States.
- C. (C.) PLATENSE, d'Orb.
- C. Platense, d'Orb., A. Mer., p. 120, Pl. 4, f. 12-14. Tert.; Arg. Rep.
- C. (C.) PUELCHUM, Sby.
- C. id., Sby., Darwin, p. 251, Pl. 2, f. 15. Tert.; Chile.
- C. (*Lævicardium*) PERTENUE, Gabb, Jour. Conch., 1869, p. 30.
- Id. Gabb, present paper. Tert.; Peru.
- C. (*Hemicardia*) AFFINIS, Nelson.
- Hemicardia id., Nelson, Tr. Conn. Acad., v. 2, p. 204. Tert.; Peru.
- LUCINA PATAGONICA, d'Orb., A. Mer., p. 161. Tert.; Pat.
- ?CORBIS LÆVIGATA, Sby., Darwin, p. 250, Pl. 2, f. 11. Tert.; Chile.
- CRASSATELLA GIBBOSA, Sby., Proc. Zool. Soc., 1832, p. 56.
- Id. Nelson, Tr. Conn. Acad., v. 2, p. 203. Tert.; Peru.
- C. LYELLII, Sby., Darwin, p. 249, Pl. 2, f. 10. Tert.; Chile.
- VENERICARDIA PATAGONICA, Sby. (sp.)

- Cardita id.*, Sby., Darwin, p. 251, Pl. 2, f. 17. Tert.; Chile.
 UNIO DILUVII, d'Orb., A. Mer., p. 127, Pl. 7, f. 12-13. Tert.; Pat.
 ANODON BATESII, Woodw., A. M. N. H., 1871, p. 103, Pl. 5, f. 10. Tert.; Brazil.
 A. PEBASANA, Con., Proc. Acad. Nat. Sci., Phila., v. 26, p. 29, Pl. 1, f. 5. Tert.; Brazil.
 HYRIA LONGULA, Con. (sp.).
Triquetra id., Con., Proc. Acad. Nat. Sci., Phila., v. 26, p. 29, Pl. 1, f. 10. Tert.; Brazil.
 MYTILUS EDULIFORMIS, d'Orb., A. Mer., p. 162. Quart.; Arg. Rep.
 M. UNGULATUS, L., Gmel., Syst. No. 12.
Id. Gabb, Jour. Conch., 1869, p. 31. Tert.; Peru.
 DREISSINA (*Mytiloides*) SCRIPTA, Con., P. Acad., v. 26, p. 29, Pl. 1, f. 12-16. Tert.; Brazil.
 PERNA CHILENSIS, Con., Astr. Exped., p. 285, Pl. 48, f. 7. Tert.; Chile.
 P. GAUDICHAUDII, d'Orb., A. Mer., p. 181, Pl. 15, f. 14-16. Tert.; Chile.
 ARCA (*Anomalocardia**) BONPLANDIANA, d'Orb.
Arca id., d'Orb., A. Mer., p. 130, Pl. 14, f. 15-18. Tert.; Pat.; Arg. Rep.
 A. (A.) LARKENI, Nelson.
Arca Larkeni, N., Trans. Conn. Acad., v. 2, p. 204, Pl. 7, f. 5-7. Tert.; Peru.
 A. (*Scapharca*) RAIMONDII, Gabb, Jour. Conch., 1869, p. 31.
Id. Gabb, present paper. Tert.; Peru.
 CUCULLÆA ALTA, Sby., Darwin's S. A., p. 252, Pl. 2, f. 22-23. Tert.; Pat.
 AXINÆA COLCHAGUENSIS, Hup. (sp.).
Pectunculus id., Huppé, Gay's Chile, p. 302. Tert.; Chile.
 A. PAYTENSIS, d'Orb. (sp.).
Pectunculus id., d'Orb., A. Mer., p. 129, Pl. 15, f. 11-13.
Axinæa id., Gabb, Jour. Conch., 1869, p. 31. Tert.; Peru.
 LIMOPSIS INSOLITA, Sby. (sp.).
Trigonocelia id., Sby., Darwin's S. A., p. 252, Pl. 2, f. 20-21. Tert.; Pat.
 NUCULA PUELCHA, d'Orb., A. Mer., p. 162. Quart.; Pat.
 ?N. GLABRA, Sby., Darwin, p. 251, Pl. 2, f. 18. Tert.; Pat.
 This looks much more like one of the *Tellinidæ*, and Sowerby described it only from the surface, not having seen any of the internal characters.
 NUCULANA ACUMINATA, Nelson (sp.).
Leda id., Nelson, Tr. Conn. Acad., v. 2, p. 205, Pl. 7, f. 8. Tert.; Peru.
 N. ELEGANS, Hup. (sp.).
Nucula id., Hup., Gay's Chile, p. 305, Pl. 5, f. 3. Tert.; Chile.
 NUCULANA (*Adrana*) LANCEOLATA, Sby. (sp.), H. & A. Ad., Gen. Moll.
Nucula id., Sby., Genera, f. 1.
Id. d'Orb., A. Mer., p. 162. Quart.; Pat.

* The name *Anomalocardia* given by Klein to this group of *Arcas* was undoubtedly the oldest, and it has been adopted by some modern authors, so that no subsequent synonym has been proposed. As I have expressed myself emphatically elsewhere against the use of Klein's names, there is little to add. He was only occasionally, and by accident binomial. I admit the name here, however, to avoid the necessity of proposing a new one myself. Schumacher's *Anomalocardia*, now half a century old, is valid as a genus, or subgenus (according to individual views) in the *Veneridæ*, and here is a good opening for somebody, more ambitious than myself, to attach his name to a good subgenus, or genus, as he may prefer to call it, in the *Arcas*.

NEILO ORNATA, Sby. (sp.).

Nucula id., Sby., Darwin's S. A., p. 251, Pl. 2, f. 19.

Tert.; Pat.

PECTEN ACTINODES, Sby., *id.*, p. 253, Pl. 3, f. 33.

Tert.; Pat.

P. CENTRALIS, Sby., *id.*, p. 253, Pl. 3, f. 31.

Tert.; Pat.

P. GEMINATUS, Sby., *id.*, p. 252, Pl. 2, f. 24.

Tert.; Pat.

P. PARANENSIS, d'Orb., A. Mer., p. 132, Pl. 7, f. 5-9.

Id. Sby., Darwin's S. A., p. 253, Pl. 3, f. 30.

Very closely allied to *P. Madisonius* of the North American Miocene, but differs in having a few more ribs, although the details of their ornaments are the same. Mr. Conrad, whose experience with these fossils extends over nearly half a century, and therefore must be treated with great deference, assures me that the North American fossils differ more among themselves, than does the South American form from the typical *Madisonius*, and that he would not hesitate in uniting them.

P. PATAGONENSIS, d'Orb., A. Mer., p. 131, Pl. 7, f. 1-4.

Tert.; Pat.

P. PROPINQUUS, Hup., Gay's Chile, p. 291, Pl. 5, f. 2.

Tert.; Chile.

P. PURPURATUS, Lam., A. S. V., v. 7, p. 134.

Id. Gabb, J. Conch., 1869, p. 32.

Tert.; Peru.

P. RUDIS, Sby., Darwin's S. A., p. 254, Pl. 3, f. 32.

Tert.; Chile.

P. TENUICOSTATUS, Hup., Gay, p. 291, Pl. 5, f. 4.

Tert.; Chile.

P. (*Pleuronectia*) DARWINIANUS, d'Orb.

Pecten Darwinianus, d'Orb., A. Mer., p. 133.

Id. Sby., Darwin's S. A., p. 253, Pl. 3, f. 28-39.

Tert.; Pat.; A. Rep.

ANOMIA ALTERNANS, Sby., *id.*, p. 252, Pl. 2, f. 25.

Tert.; Chile.

OSTREA ALVAREZII, d'Orb., A. Mer., p. 134, Pl. 7, f. 19.

Tert.; Arg. Rep.

O. COPIAPINA, Con., U. S. Naval Astron. Exped., p. 285.

Tert.; Chile.

O. FERRARISI, d'Orb., A. Mer., p. 134, Pl. 7, f. 17-18.

Tert.; Pat.

O. GALLUS, Val., Voy. Venus, Pl. 21, f. 1.

O. *Cerrosensis*, Gabb, Pat. Col., v. 2, p. 35, Pl. 11, f. 61.

O. *gallus*, Gabb, J. Conch., 1869, p. 32.

Tert.; Chile.

O. MAXIMA, Hup., Gay, p. 282, Pl. 4, f. 1.

Tert.; Chile.

O. PATAGONICA, d'Orb., A. Mer., p. 133, Pl. 7, f. 14-16.

Tert.; Pat.; Arg. Rep.

O. PUELCHANA, d'Orb., A. Mer., p. 162.

Quart.; Arg. Rep.

O. ROSTRATA, Hup., Gay's Chile, p. 283.

Tert.; Chile.

O. TRANSITORIA, Hup., Gay's Chile, p. 283, Pl. 4, f. 3.

Tert.; Chile.

BRACHIOPODA.

TEREBRATULA FONTAINI, d'Orb., A. Mer.

T. Chilensis, d'Orb., Foss. A. Mer., p. 163.

Not *T. id.*, Brod.

T. Fontainei, Hup., Gay's Chile, p. 400.

Quart.; Chile.

T. PATAGONICA, Sby., Darwin's S. A., p. 252, Pl. 2, f. 26-27.

Tert.; Pat.

RADIATA.

ECHINODERMATA.

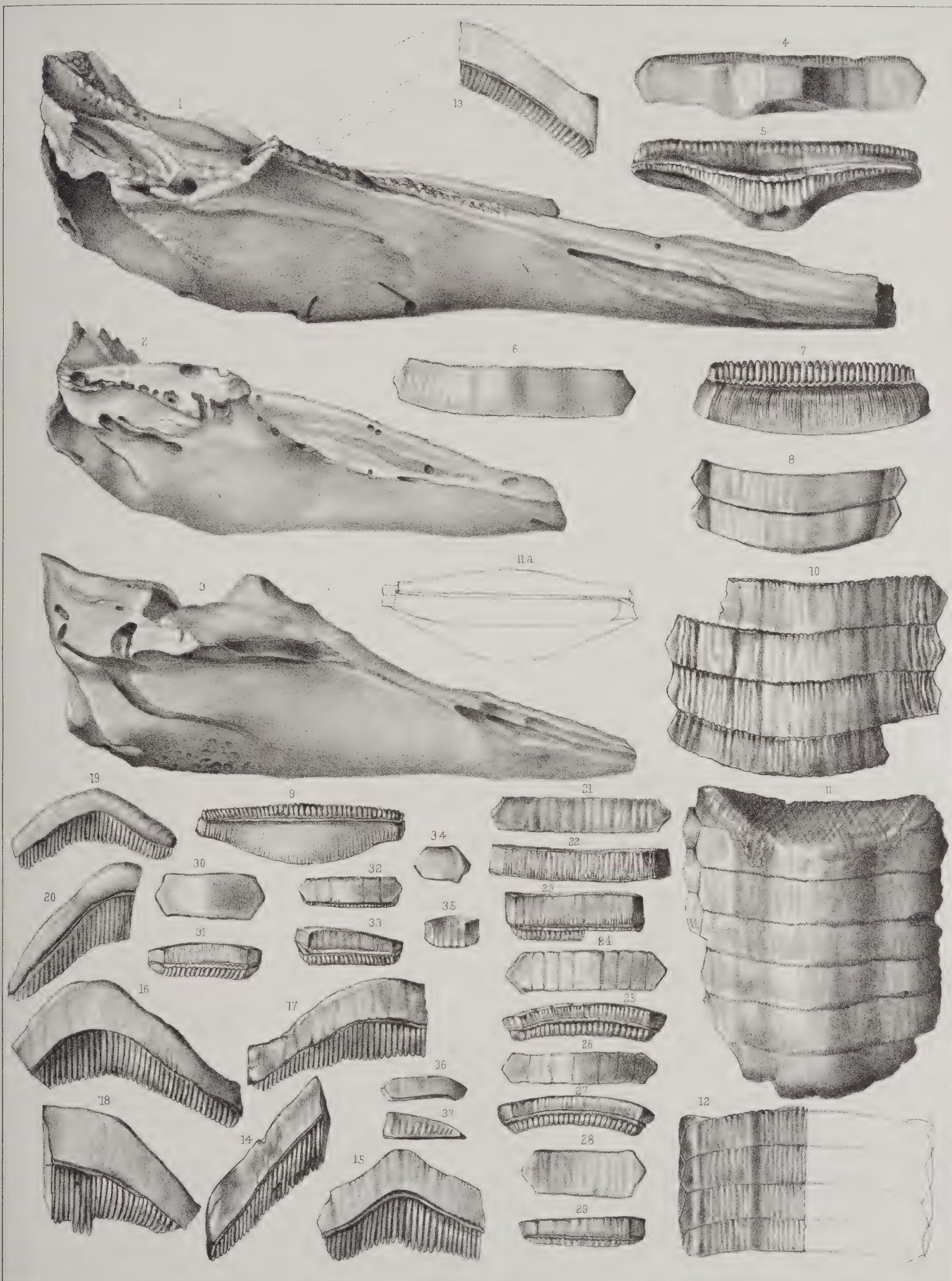
ECHINUS PATAGONENSIS, d'Orb., A. Mer., p. 135, Pl. 6, f. 14-16.

Tert.; Pat., Arg. Rep.



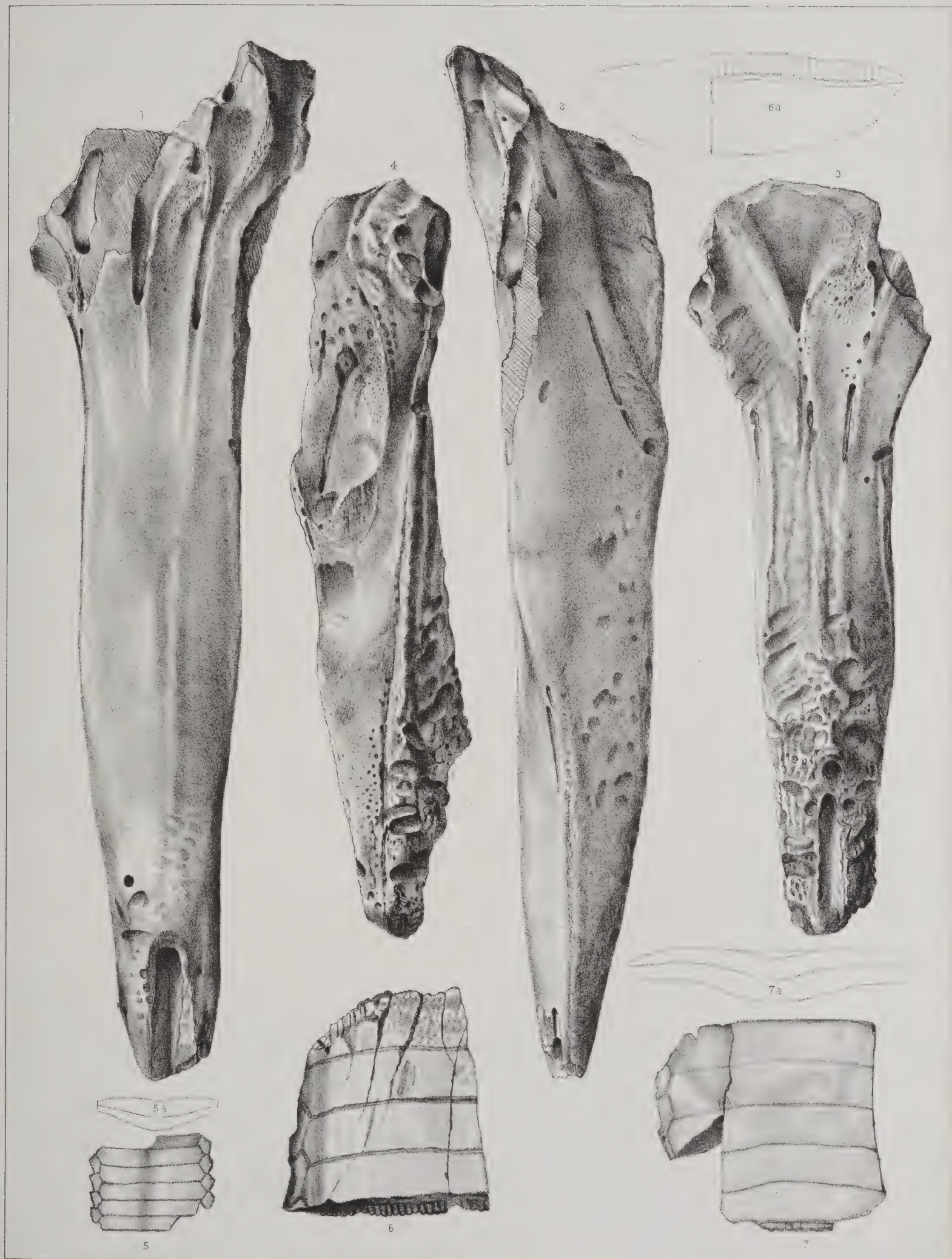
T. Sinclair & Son, lith. Phila.

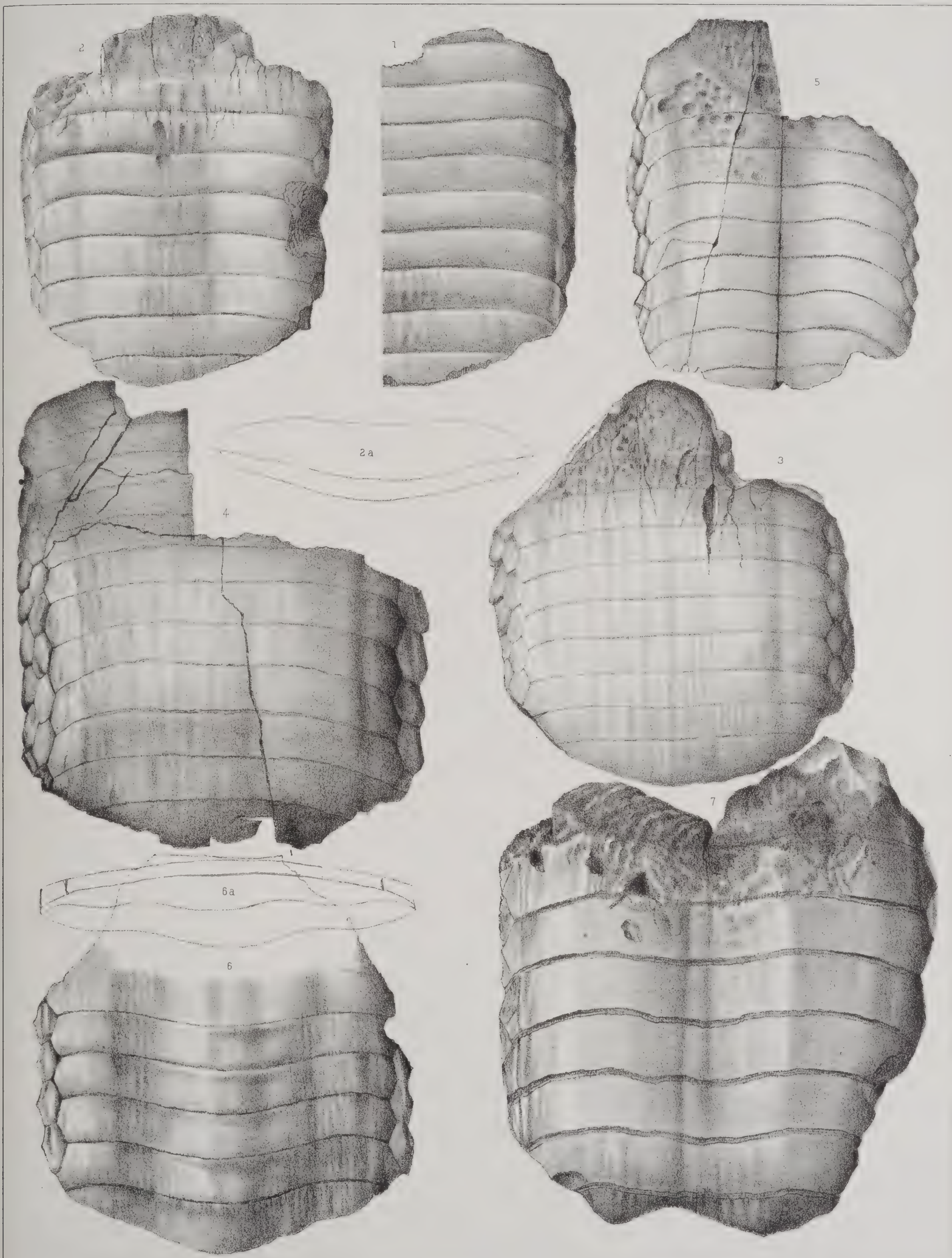
1 *Choneziphius liops*. 2 *C. trachops*. 3-4 *Dioplodon prorops*. 5 *Eboroziphius coelops*. 6 *Rosmarus obesus*. 7-11 Cetacean teeth.



T. Sinclair & Son, lith. Phila

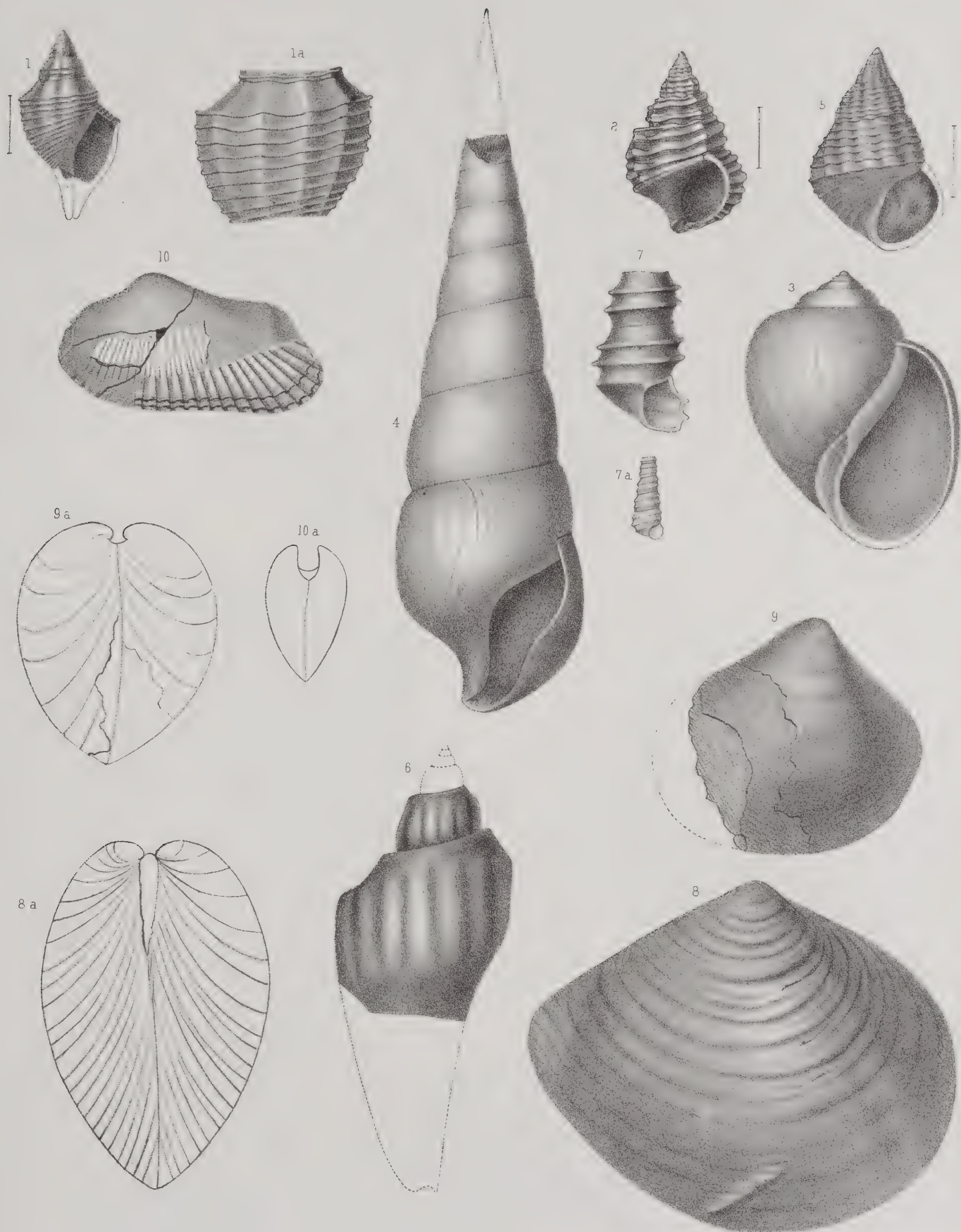
1 *Choneziphius trachops*. 2 *C. liops*. 3 *Eboroziphius coelops*. 4-5 *Myliobates jugosus*. 6-10 *Mobesius*. 11 *M. fastigiatus*.
12 *Meximius*. 13 *Aetobatis perspicuus*. 14-18 *A. arcuatus*. 19-20 *A. profundus*. 21-37 *Zygobates dubius*.





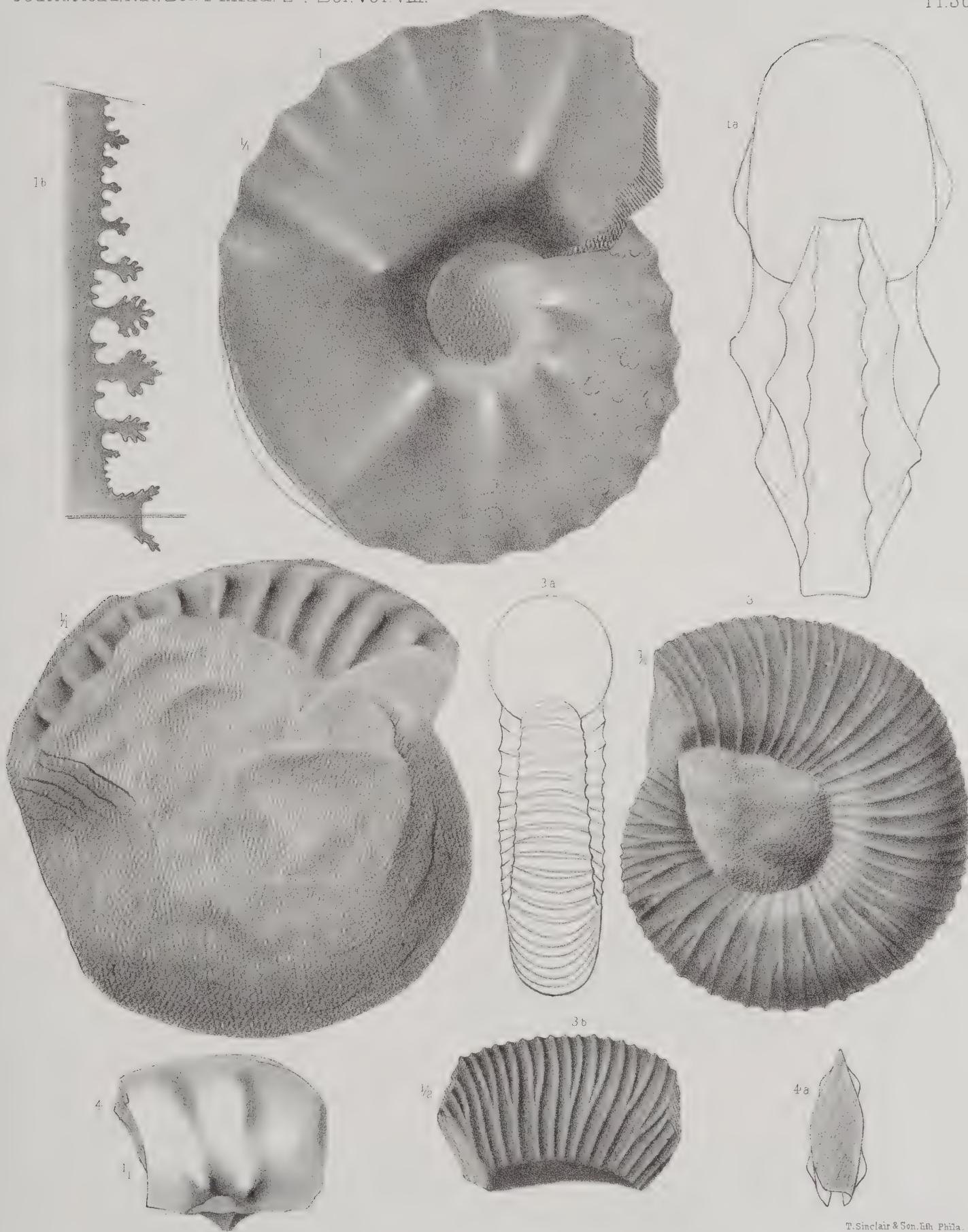


1-2 *Geratoptera unios*. 3 *Trionyx*. 4-5 *Eupachemys obtusus*. 6 *Dinoziphius carolinensis*. 7 *Ceterhinops longifrons*. 8 *Symphiodontis ancus*. 10-13 *Acrodontis serra*. 14 *A. obliquus*. 15-18 *Diodon vetus*. 19-24 *Pharyngodon pilus carolinensis*. 25-30 *Xiphodolamia ensis*. 31-32 *Pristis ensidens*. 33-34 *Xenodolamia pravus*. 35-36 *X. simplex*. 37-41 *Sphyræna*. 42-43 *Megatherium*. 44 *Myliobates obesus*. 45 Shark tooth from Texas.



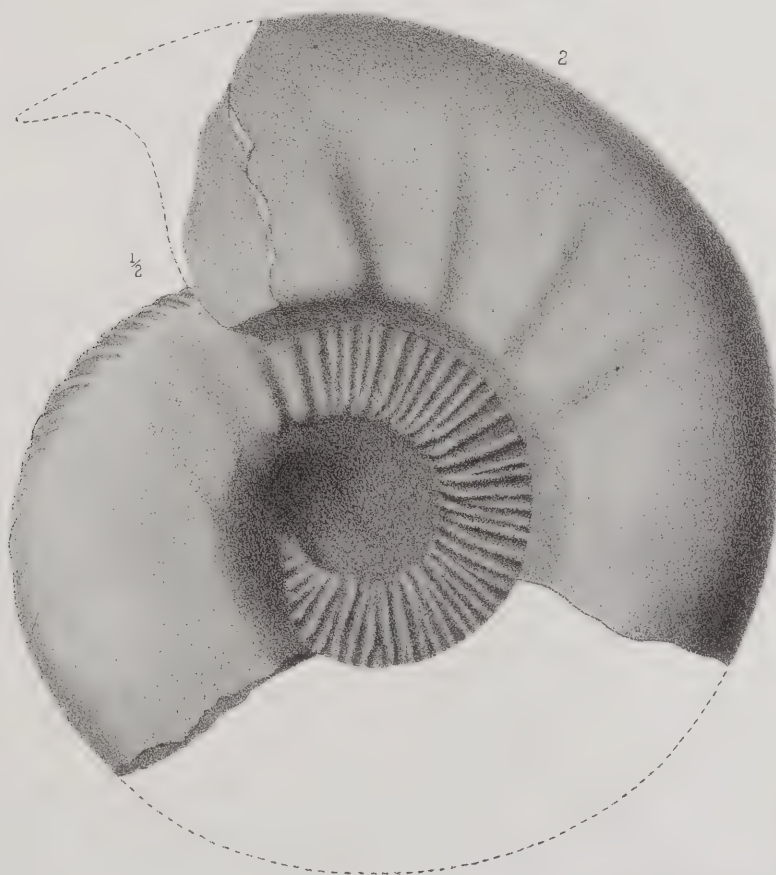
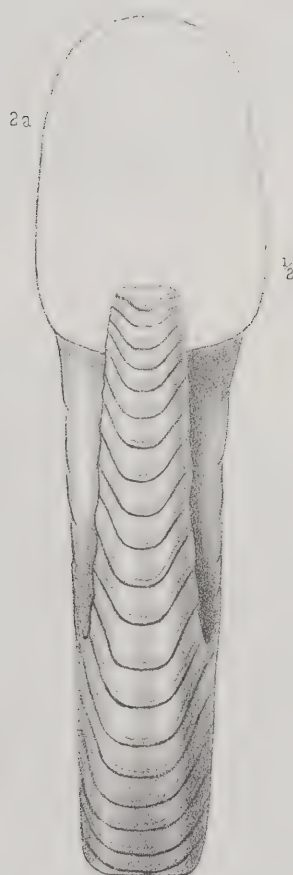
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Gabb on Peruvian Fossils.

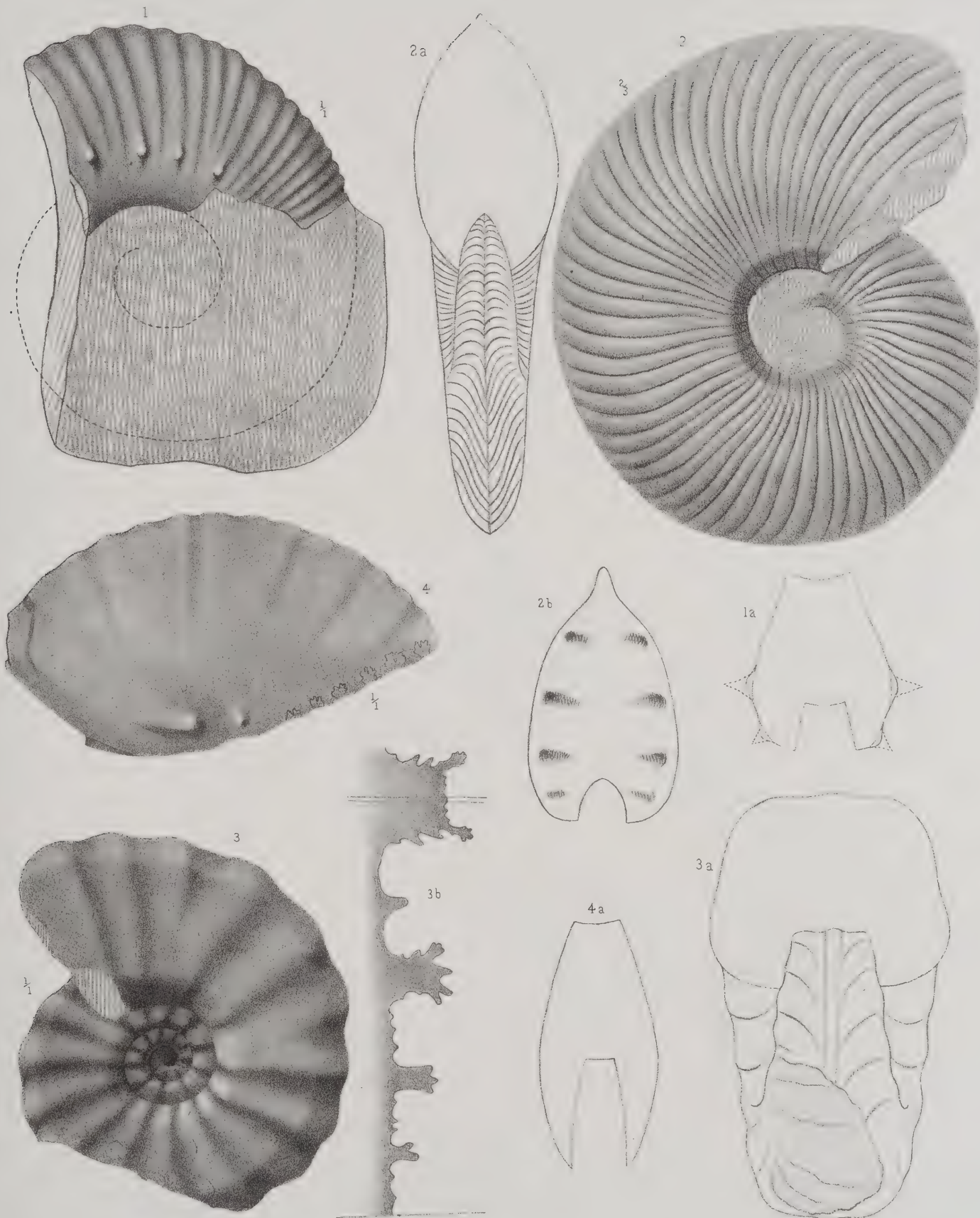


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Gabb on Peruvian Fossils.



Gabb on Peruvian Fossils.



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Gabb on Peruvian Fossils.



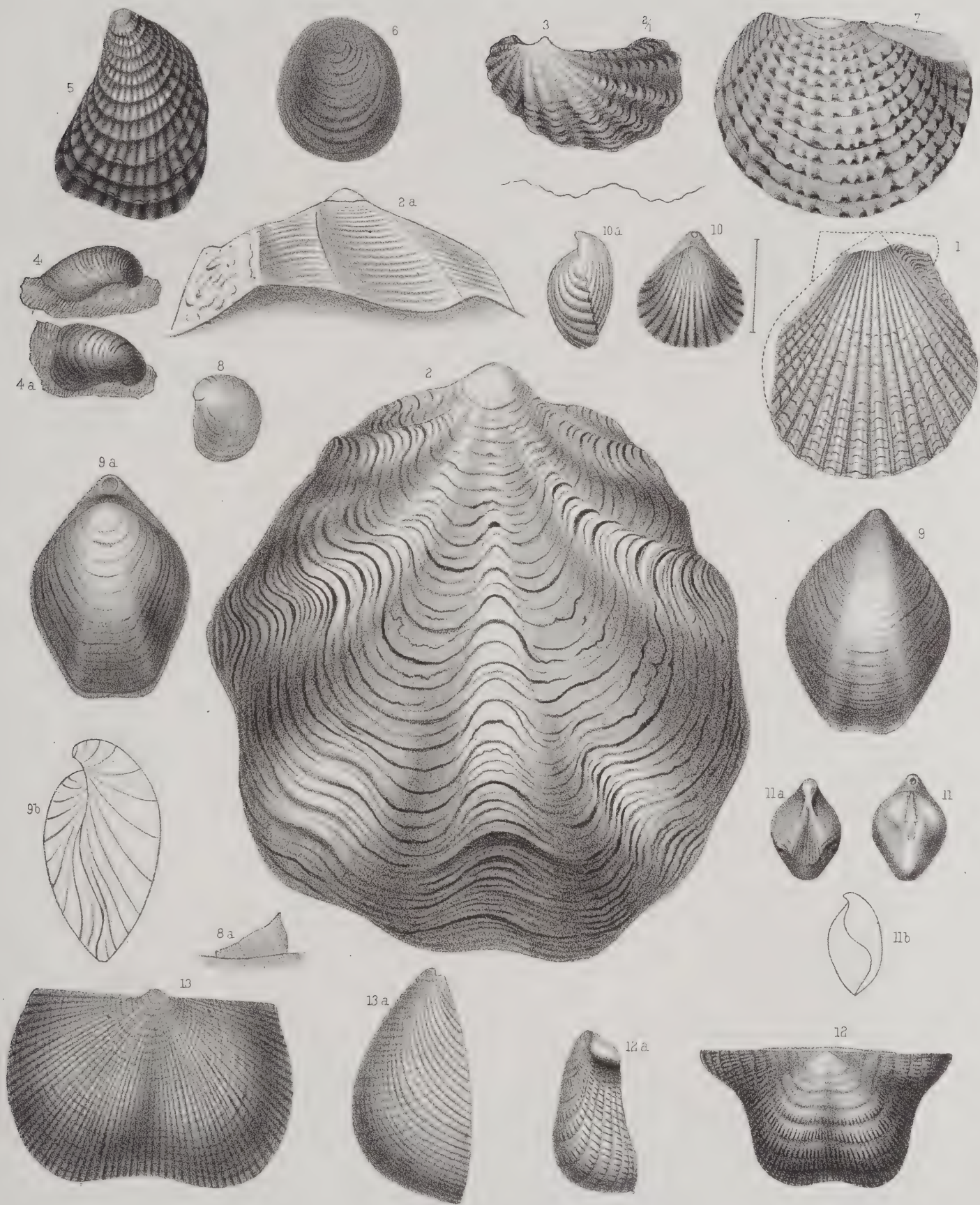
T. Sinclair & Son, lith. Phila.

Gabb on Peruvian Fossils.



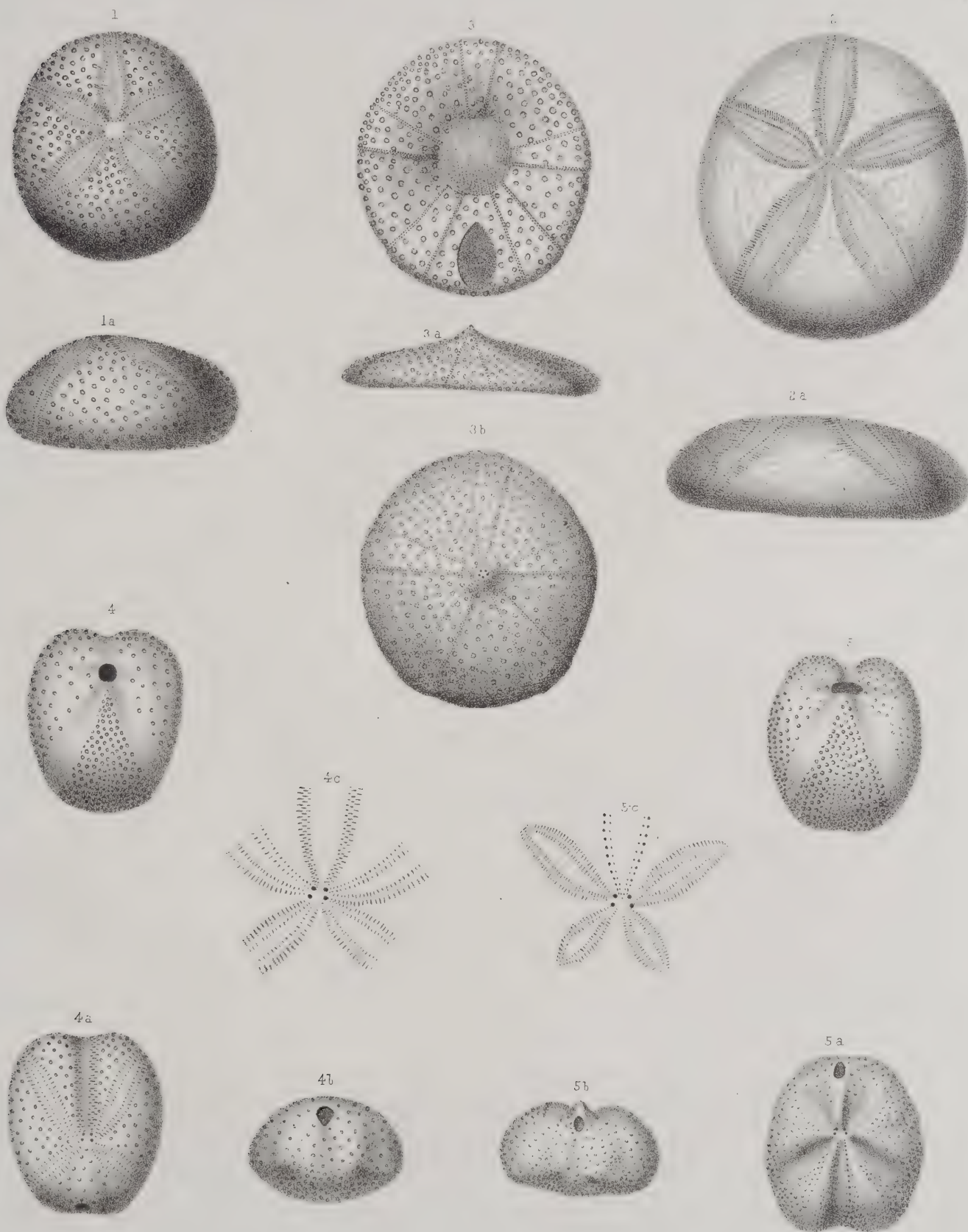


Gabb on Peruvian Fossils.



Gabb on Peruvian Fossils.

T. Sinclair & Son. lith. Phila



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Gabb on Peruvian Fossils.

Descriptions of Caribbean Miocene Fossils.

By WILLIAM M. GABB.*

I USE the term Caribbean in preference to a more restricted one, since I have not only my own collections from Costa Rica, but there are also in the museum of the Academy of Natural Sciences of Philadelphia a few fossils collected by Dr. Newberry at Gatun, on the Panama Railroad, which I include here, as well as occasional notes on West Indian species.

NAUTILUS, Breyn.

A very imperfect cast of an unrecognized species, about six inches in diameter, in the above-mentioned collection of Dr. Newberry.

STYLIOLA, Lesueur.

S. BICOSTATA, Gabb, n. s., Pl. 44, fig. 1.

Shell minute, apical angle broad, aperture elliptical, the longest diameter being transverse, each side bearing a very faint ridge. No other ornaments. The apex, instead of being compressed in the same direction as the mouth, is markedly compressed at a right angle to that direction.

Figure. Magnified $6\frac{1}{2}$ times linear.

Locality. Sapote, on the Reventazon River, Costa Rica. Very rare. Differs from its Dominican congener (*S. sulcifera*) in the absence of the groove and in its having its apex and mouth both elliptical, but placed in opposite directions.

DRILLIA, Gray.

D. MILITARIS, Hds.

Pleurotoma consors, Sby., Guppy.

For details of synonymy see Memoir on Santo Domingo.

Mr. Guppy (*Quart. Journ. Geol. Society*, 1876, p. 527) repeats his dissent from my determination. I did not arrive at it without careful study of large numbers

* This and the following paper were written by the late Mr. Gabb whilst in San Domingo, during the winter of 1877-78. He returned to Philadelphia too ill to make some necessary references to books and specimens in the Academy of Natural Sciences, and a few hours before his death he committed his material to my hands with the request that I would edit it. This I have done to the best of my ability, but from want of knowledge of the subject, I have necessarily refrained from pursuing a number of lines of inquiry which Mr. Gabb had noted as requiring his further investigation.

GEO. W. TRYON, JR.

of specimens, and repeat my conviction of the identity of the species. Found very rare, but perfectly recognizable, at Sapote, on the Reventazon River.

PHOS, Montfort.

P. INORNATA, Gabb, n. s., Pl. 44, fig. 2.

Shell moderately large, robust, a little variable in the height of the spire, but with the spire and aperture of approximately equal lengths. Whorls, including the nucleus, about eight or nine. All of my specimens are so broken at the extreme apex as to make about two very small volutions possible, and the specimen figured thus broken retains seven. Suture linear, not very strongly marked; volutions slightly angulated, and sloping steeply from the suture. Whorls marked by not very strong longitudinal ribs, which develop into angular tubercles on the back of the body whorl. These are crossed in some specimens by a few hair-like, revolving, elevated lines, most strongly marked on the upper volutions. In other examples these lines are only detected by a glass, or are entirely absent.

Figure. Natural size.

OLIVA, Brug.

O. ISPIDULA, Linn.

Found at Sapote, on the Reventazon River.

MALEA, Val.

M. RINGENS, Wood.

Although I have not found this species fossil on the main land, Mr. Conrad reported it from Gatun on the Isthmus, among the collections of the Pacific Railroad party. See Report P. R. R. Exp., v. 6, p. 72, pl. 5, f. 22.

NATICA, Lam.

N. MILLERI, Gabb, n. s., Pl. 44, fig. 3.

Shell small, flattened subglobular; apex elevated; suture well marked, but not indented or grooved; aperture broad; the thickening of the inner lip not very heavy; umbilical callus small, but well marked, and running spirally up the rather narrow umbilicus. Whorls five and a half; surface smooth.

Figure. Nearly twice natural size.

Locality. Sapote; found for me by Mr. Silvanus Miller, the engineer in charge of that section of the Costa Rican Railroad, and a gentleman to whom I am indebted for many similar favors, both in palæontology and in archæology.

Of previously described species, this resembles most in its form *Lunatia semi-lunata*, Lea, of the Eocene of Claiborne, Alabama, but it is flatter than that, and the umbilicus is smaller.

LUNATIA, Gray.

L. EMINULOIDES, Gabb, n. s., Pl. 44, fig. 4.

Shell small, elongated subglobular, somewhat higher than wide; apex elevated, whorls five, rounded, not prominent; suture small but sharp; surface marked by fine lines of growth; mouth long vertically; inner lip not very heavily thickened; umbilicus small, but well defined.

Figure. Twice natural size.

Locality. With the preceding, found also by Mr. Miller. Allied to *L. eminula*, Conrad, from the Eocene of Claiborne, Ala., but with a proportionately much smaller spire. That species has one volution more than this in a shell of the same size.

L. SCULPTURATA, Gabb, n. s., Pl. 44, fig. 5.

Shell small, elongated, slightly oblique, whorls increasing rapidly in size, so that the upper are nearly hidden by the body whorl; surface more convex below than above; suture well marked by a very narrow flattening of the tops of the succeeding volution; surface evenly sculptured by about thirty regular, small, equidistant impressed lines. Inner lip well thickened where in contact with the body whorl; gradually diminishing in advance. Umbilicus well marked.

Figure. Slightly magnified.

Locality. Sapote, Costa Rica; also found by Mr. Miller.

SIGARETUS, Lam.

S. MULTILINEATUS, Gabb, n. s., Pl. 44, fig. 6.

Shell small, very oblique; body whorl increasing very rapidly in size; spire small, convex, whorls few, apparently not more than four, perhaps four and a half. In one specimen the apex is broken, and in the only other two that I have, the manner of the fossilization makes the count at the extreme apex uncertain. Surface ornamented by very numerous, small revolving ribs, showing something of a tendency to alternation in size on the side of the body whorl. Aperture oblique, large; thickening of umbilical margin well marked, terminating externally in a sharp edge, and sloping into the mouth.

Figure. About twice linear size.

Found with all the other new Naticoids of this paper at Sapote, Costa Rica, by Mr. S. Miller.

Most nearly allied to *S. declivis*, Conrad, of the Eocene of Claiborne, but the ribs of this species are smaller and more closely placed, and the umbilical margin is broader and flatter.

S. NUMISMALIS, Gabb, n. s., Pl. 44, fig. 7, 7a.

Shell depressed, broadly expanded laterally; spire small, not much elevated, consisting of about four whorls; suture minutely impressed; surface marked only by a few faint lines of growth; umbilicus patulous; details of mouth unknown.

Figure. Natural size.

Locality. With the preceding.

From its shape, this seems to belong to the subgenus *Cryptostoma*, Blainv., but the imperfect condition of the mouth of my only specimen renders the determination even of the genus, not to speak of the subgenus, somewhat doubtful.

TEREBRA, Brug.

T. DISLOCATA, Say.

Cerithium id., Say, Journ. Phil. Acad., 1 Ser. v. 2, p. 236.

Of this well-known recent species, found on the Atlantic coast of the United States, and fossil in the Santo Domingo miocene, I obtained a few specimens from Sapote, Costa Rica. I have compared them carefully with specimens of the recent shells in the museum of the Academy, possibly Say's original types, and I am satisfied in the identification.

T. EVANSII, Gabb, Pl. 44, fig. 8.

id., Gabb, Proc. Phila. Acad. 1860.

Shell unusually short and thick for a member of this genus—resembling more in its form an *Obeliscus*. Whorls scalariform, flat, and nearly vertical on the sides, and truncated on top adjoining the suture. Surface, besides the lines of growth, generally, though not in every case, carries one impressed revolving line a little above the middle of the volution. Mouth moderate, ending in a short twisted, notched canal, as is characteristic of this genus. Inner lip encrusted with a smooth shining layer, columella ending in a twisted fold in front, and carrying another above.

Figure. Natural size.

Locality. I described this, with one or two other fossils, a number of years ago, out of a collection made by Dr. John Evans, United States geologist, who went officially to Chiriqui Lagoon, State of Panama, to examine some miocene coal beds. I pronounced their age then, on rather scanty material, but my own later observations on the same coal deposits in Costa Rica, amply confirm the old determination.

STROMBUS, Linn.

S. PUGILIS, Linn., Syst. Nat. (12 Ed.), p. 1209.

For synonymy see memoirs on Sto. Domingo, Tr. Amer. Phil. Soc., v. 15.

Although Mr. Guppy (Quart. Journ. Geol. Soc., 1876, p. 521) gives his reasons

for dividing this species into three: viz., the original *pugilis*, *proximus*, Sby., and *bifrons*, Sby., I cannot agree with him. I have noted carefully also his description of his species *pugiloides*, in Geol. Magazine, 1874.

Naturally, living in the West Indies, and being an enthusiastic collector and careful student, it is impossible that Mr. Guppy should have failed to have seen large numbers of these shells; and to contradict him with authority, one must have had equal advantages. This I claim. I have handled, sorted, arranged, and rearranged hundreds of the fossil forms, and have failed to find the dividing lines. With fewer specimens the task would have been easier. So much for the fossils. As to the recent; I once made an excavation in a kitchen-midden in Samaná, made up almost exclusively of this species. On that occasion I am sure it is no exaggeration to say that at least twenty tons of the shells of *Strombus pugilis* were thrown out under my inspection, and that when I was working at the fossils, and had the question of specific identity strongly in my mind. I think I know the species, and persist in my synonymy, adding *pugiloides* to the list.

I found one or two specimens at Sapote, Costa Rica.

TURRITELLA, Lam.

T. ALTILIRATA, Con., Pl. 44, fig. 9, 9a.

id., Conrad, Pacific Railroad Report, vol. 6, p. 72, Pl. 5, fig. 19.

There is little to be said in describing this species. Mr. Conrad's original specimen corresponded with our figure 9, in which the two principal ribs on the whorl are of nearly equal size. Another variety, found by me, has the upper rib very much smaller. All of the specimens are marked by such strong, rough lines of growth, that the large ribs always, and the small ones sometimes, present decided beadings.

Figures. Natural size.

The specimens figured are from Sapote, Costa Rica. The species was originally described from Gatun, on the Panama R. R., whence there are now specimens in the Academy's museum from the Newberry collection.

On placing this shell beside specimens of Guppy's *T. tornata*, the only points of difference that I can find are, first—its much greater size always—I have never seen a *tornata* as large as the smallest *altilirata* that has come into my possession. Again, while both species possess two principal ribs, *altilirata* always has a few more finer intermediate ribs; a character, however, in which it varies much more within itself than it differs from Dominican specimens of Guppy's species.

Finally, *altilirata* has a very slightly broader angle, but this might readily be accounted for by the difference in size, a variation not rare in very elongate shells.

T. GATUNENSIS, Conrad, Pl. 44, fig. 10, 10a.

id., Con., Pacific R. R. Report, vol. 6, p. 72, Pl. 5, fig. 20.

It is remarkable that with the two representative species just quoted, we should have them accompanied by another pair. *T. tornata* and *T. altilirata* are so closely allied that they may be safely referred to an intermediate common source. *T. Gatunensis* is a round-whorled shell with three or four large and numerous finer ribs, and so is *T. planigyrate*.

Figures. Natural size.

Locality. The specimens figured were found by me in the deep cañon of Oronli Creek, a tributary of the upper part of the Uren river, near the base of Pico Blanco, in Talamanca. It was originally described from Gatun, on the Panama R. R., and there are specimens in the Academy's collection from that locality, from Dr. Newberry.

TROCHITA, Schem.

T. COLLINSII, Gabb, n. s., Pl. 44, fig. 11, 11a.

Shell small, inconspicuous, conical, apical angle very variable, usually rather low, shell often oblique or crooked. Surface unornamented. Apical volutions one-and-a-half, minute, but distinct. Internal plate thick.

Largest specimen, fig. 11a, 5 mm. in diameter.

Locality. Sapote, Costa Rica.

Named after Mr. Wm. P. Collins, my topographical assistant in the exploration of Talamanca.

KUPHUS, Guett.

K. INCRASSATUS, Gabb, Pl. 44, fig. 12a-e.

id., G., Memoir on Sto. Domingo, Tr. Amer. Philosoph. Soc., v. 15.

I quoted this species originally as from only one known locality. Since then I have found it in nearly the whole range of the Samba hills, and south of Samana Bay, in Santo Domingo, a very common and characteristic fossil of the upper part of the Dominican Miocene. Besides, I was fortunate enough to find one small fragment at Sapote, Costa Rica; and so perfect and characteristic is it that no more is necessary. It is figured at 12e, all the others being from Santo Domingo. All the figures except the first are actual size; that is one-third natural size, though I have seen still larger. The shell substance of the tube is so thick and invariably crystalline that long fragments are very rare, and I have never been able to find the valves.

CORBULA, Brug.

C. LAVALEANA, d'Orb., La Sagra's Cuba, Pl. 27, figs. 9-12.

C. disparilis, d'Orb., *loc. cit.*, Pl. 27, figs. 1-4.

Both species found at Sapote, on the Reventazon.

TELLINA, Linn.

T. DARIENA, Conrad, Pl. 44, fig. 13.

id., Conrad, Pacific R. R. Report, vol. 5, p. 328, Pl. 6, f. 53.

T. semilævis, Gabb, Proc. Phila. Acad., 567, 1860.

First described by Conrad, from the Isthmus. I renamed it in the Evans collection from Chiriqui, where it is abundant in the black shale near the coal; and I have subsequently found it in the Oronli cañon associated with *Turritella Gatunensis* and the *Arca* described below.

No specimens have ever been found showing the hinge, so the subgenus must remain uncertain, though the form certainly allies it to *Peronæoderma*.

Figure. Natural size.

T. SP. INDET., Pl. 44, fig. 14, 14a.

A single internal cast from Sapote which retains the cast of the hinge, and but few other details except the general outline. It seems to be an *Arcopagia*, from the strong lateral teeth and the slightly twisted posterior end.

Figure. Natural size.

MERETRIX, Lam.

M. SAPOTENSIS, Gabb, n. s., Pl. 44, fig. 15.

Shell moderately large, convex, thin; inequilateral, the small strongly incurved beaks being about a third of the total length from the anterior end, which is narrow and produced, most prominent a little above the middle and sloping up nearly straight to the beaks with a very faint convexity in the lunular region. Posterior cardinal margin broadly curved and sloping to the end of the shell, which is broad and round; base forming almost a third of a circle, not perfect in outline however, being a little more prominent near the front edge of the pallial sinus, and also being markedly straightened as it slopes upwards in front. Surface marked by small concentric ribs, evidently polished when alive. The lunule, rather large, is bordered by an impressed line, so faint as only to be visible with a glass in certain directions of reflected light. Internal margin smooth; pallial sinus small and angular.

Figure. Natural size.

Locality. Sapote, Costa Rica, where I found only the specimen figured.

The generic determination given above is, I believe, correct; although I cannot be perfectly positive. The shell is crystalline and imbedded in tough sandstone. I succeeded in uncovering a portion of the hinge, and the teeth, so far as I could see, warrant my determination.

CALLISTA, Poli.

C. MACULATA, Linn., sp.

Venus maculata, Linn., Syst. Nat., p. 1132.

Cytherea (meretrix) Dariena, Con., Pacific R. R. Report, v. 6, p. 72, Pl. 5, fig. 21.

Not *id.*, vol. 5, p. 328, Pl. 6, fig. 55.

Mr. Conrad redescribed this shell from Gatun; and I have since encountered it at Sapote.

CYCLINA, Dest.

C. cyclica, Guppy.

Dosinia id., Guppy, Quart. Journ. Geol. Soc., vol. 22, p. 582, Pl. 22, f. 15.

Cyclina id., Gabb, Tr. Amer. Philos. Soc., v. 15.

A single specimen in the Newberry lot from Gatun.

CLEMENTIA, Gray.

C. DARIENA, Conrad, Pl. 44, fig. 16, 16a.

Meretrix Dariena, Con., Pacific Railroad Report, vol. 5, p. 328, Pl. 6, f. 55.

Not *Cyth. (M.) Dariena*, Con., loc. cit., vol. 6, p. 72, Pl. 5, f. 21.

I found a beautifully preserved specimen at Sapote, and had the satisfaction of convincing Mr. Conrad of the above synonymy. It is figured of natural size. A poor specimen occurs in the Newberry lot in the Academy's museum.

CARDIUM, Linn.

C. (PROTOCARDIA) NEWBERRYANUM, Gabb, n. s., Pl. 44, fig. 17.

I propose this name for the internal mould of a *Protocardia* in the Newberry collection from Gatun. Although only a cast, it is clearly an unnamed species, and its form is so characteristic that it cannot be mistaken. It is nearly equilateral, unusually strongly truncated posteriorly, and the base is gently excavated in front of the posterior angle. Being a cast, of course no surface characters are obtainable, and being somewhat compressed, the amount of its convexity is uncertain.

Figure. Natural size.

C. (TRACHYCARDIUM) DOMINICENSE, Gabb, Tr. Amer. Phil. Soc., vol. 15.

Found by me at Sapote, Costa Rica, and by Dr. Newberry at Gatun.

C. (LÆVICARDIUM) MILLERI, Gabb, n. s., Pl. 44, fig. 18.

Shell small, convex, rounded subquadrate, nearly equilateral; beaks central; rather prominent, incurved, approximated, and with apex pointed very slightly forward. Anterior end and base broadly rounded; posterior end very faintly truncated. Surface marked by a faint cross-lining of radiating lines and those of growth, nearly microscopic in its fineness. Internal margin minutely crenulated.

Figure. Slightly magnified.

Given to me by Mr. S. Miller, who found it at Sapote, Costa Rica.

LUCINA, Brag.

?*L. SP. INDET.*, Pl. 44, fig. 19.

A single internal cast from Sapote, too imperfect for positive determination. It shows no specific character except outline, and none generic except the posterior umbonal depression common in this genus.

CRASSATELLA, Lam.

C. MACTROPSIS, Con., sp., Pl. 44, fig. 20.

Gratelupia id., Con., Pacific R. R. Report, vol. 5, p. 328, Pl. 6, f. 54.

C. Antillarum? Gabb, Tr. Amer. Philos. Soc., vol. 15.

Not *id.*, Rve., Zool. Proc., 1842, p. 44, Icon. sp. 8.

C. Reevei, Gabb (Provis. name), Tr. A. P. S., v. 15.

When I published this species as coming from Santo Domingo, on account of deficient material I referred it provisionally to Reeve's species; at the same time doubting the determination so much that I proposed a new name if further material should confirm my doubts. But a solution comes in from another source. The hardly recognizable description and figure of Conrad, and the unpardonable generic reference has at last been made out. It was one of the last pieces of assistance the old gentleman rendered me before his death. The difference in shape of the posterior end is sufficient to distinguish it from Reeve's species. I have two specimens from Sapote, the longest of which is figured, natural size

PINNA, Linn.

P. SEMINUDA, Lam.

Abundant in the brown shale on the roadside at Sapote, forming masses. The shell is now living on the coast from Texas to Georgia.

ARCA, Linn.

A. GRANDIS, Brod. and Sby., Zool. Journ., v. iv.

A. Patricia, Sby., Guppy.

A. very like *grandis*, Moore, Quart. Journ. Geol. Soc., v. 9.

A. Chiriquensis, Gabb, Proc. Phila. Acad., 567, 1860.

While my friend Mr. Guppy repeats in his last publication his adherence to Sowerby's fossil as distinct from the living shell, I propose to go further than ever before, and add a species I described under another name eighteen years ago.

They possess such marks of difference that perhaps the name might be retained as varietal; but it *certainly* has no higher value.

A. (BARBATIA?) ORONLENSIS, Gabb, n. s., Pl. 44, fig. 21.

Shell moderate in size, elongate convex, umbones broad and placed in advance of the middle; beaks small, approximated, area narrow; hinge line about three-fourths of length of shell; posterior end sloping convexly outward; base broadly and regularly rounded. Surface marked by about twenty-eight ribs of nearly equal size, and all minutely tuberculated, especially on the middle of the shell.

Figure. Barely magnified.

Locality. From the black shale of Oronli creek, associated with *Turritella*, *Gatunensis*, and *Tellina Dariena*.

The generic reference is made entirely from the outline, since I have been unable to expose a hinge.

AXINÆA, Poli.

A. PECTINATA, Lam.

Miocene, Sapote, Costa Rica, and also found living in the present West Indian waters.

NUCULANA, Link.

N. MILLERI, Gabb, n. s., Pl. 44, fig. 22, 22a.

Shell minute, aliform; beaks two-fifths of length from the anterior end which is rounded; posterior cardinal margin slightly concave, and bordered by a flat, sloping area which extends to the posterior end. Posterior end prolonged and acute, base broadly rounded. Surface marked by regular, fine concentric lines.

Figure. Increased three times linear size.

A single broken specimen from Mr. Miller, Sapote.

PECTEN, Brug.

P. RUDIS? Sby., Darwin's Geological Observations, S. A., Pl. 3, f. 32.

An imperfect valve from the shore of the Reventazon river, a few miles above Sapote. Specimen too imperfect for positive determination or figuring.

P. THETIDIS, Sby., Pl. 45, fig. 23, 23a-b.

id., Sby., Quart. Journ. Geol. Soc., vol. 7, p. 52.

Found with the preceding. Also in the Newberry lot from Gatun.

P. PARANENSIS, d'Orb., Pl. 45, fig. 24.

Mr. Conrad and I studied this species and Conrad's *P. Madisonius* in detail, and we were both satisfied of their identity, the slight variations being geographical only. My fossil, like the South American, has a few more ribs, but the number varies in *Madisonius*; the details of sculpture are the same. My specimen is a little oblique, probably from pressure.

JANIRA, Schum.

J. SOBER, Gabb, St. Domingo Memoir, Tr. Amer. Philos. Soc., vol. 15.

A poorly preserved specimen in the Newberry lot from Gatun.

PLURONECTIA, Swains.

P. LYONII, Gabb, n. s., Pl. 45, fig. 25a-b.

Shell large, thin, flat, perfectly plain on the surface, marked by faint lines of growth, or in young shells, showing faint radiating undulations corresponding with the internal ribs. Hinge line perfectly straight and with the teeth inclined slightly downwards from the beak. Inner surface costate by small solitary ribs not running in pairs. These may or may not show signs of their existence through to the outer surface.

Figure. Natural size.

Locality. I found it not rare, but very difficult to obtain on the shore of the Reventazon river, in front of Sapote, but at a lower stratigraphical level. The rock is very tough, and it could only be obtained by chipping off in minute pieces. The specimen figured consists of seventeen fragments. Also found in the Newberry lot from Gatun.

From *P. pleuronectes* and *P. Japonica*, it differs in being slightly more convex near the beaks, the internal ribs show less tendency to run into pairs, and the ears are proportionately much larger. The specimen figured, a lower valve, has the cardinal margin of the ears, a straight line across from angle to angle, and the teeth inclined slightly downward from the beak. In the two above-named species the cardinal margins are elevated from the beak to the angles, and the teeth are in a right angle. *P. Mortoni* of the North American Miocene is a much larger shell, and the ears are proportionately still smaller, and are truncated on the outer angles. *P. Clintonius* has radiating striæ, sometimes nearly obsolete, but always visible, and sometimes developed into even low ribs. *P. papyracea*, Gabb, from St. Domingo, only two inches in diameter, is markedly inequivalve; the ears are very small, and the upper lines very oblique. *P. Darwinii*, Sby. (*Pecten*), South America, is higher shouldered, and the ears are much smaller than this.

I have named this beautiful shell after my "guide, councillor, and friend," John H. Lyon, of Sipurio, Talamanca, without whose constant aid the expedition would have been a failure.

LIMA, Brug.

L. PAPYRACEA, Gabb, n. s., Pl. 45, fig. 26.

Shell moderate in size, very thin, oblique, anterior margin very convex, posterior nearly straight. Ears small, hinge straight and rather short, beaks prominent and well curved inwards and forwards. The anterior surface—nearly half the width of the shell—is perfectly plain, as is also a narrow space bordering the posterior margin. The remainder, just about one-half of the area, carries about a dozen small, regular, thread-like, radiating ribs. (One specimen before me counts eleven, another fourteen.)

Figure. About natural size.

Locality. Sapote, Costa Rica.

OSTREA, Linn.

O. TRYONI, Gabb, n. s., Pl. 45, fig. 27.

Shell sub-rotund in outline, very convex, tri-plicate, the plicæ noduled where crossed by the growth lines. Very much thickened, slightly winged.

The figure is two-thirds the natural size.

Locality. Sapote, Costa Rica.

SCHIZASTER.

S. SCHERZERI, Gabb, n. s., Pl. 45, fig. 28, 28a, 28b.

Shell moderately large, high; most elevated posteriorly, in a crest between the two posterior ambulacral grooves. Sides pretty regularly convex, tapering more rapidly behind; posterior end high and abruptly truncated, anterior end sloping. Ambulacral grooves profound. Mouth broad, bordered by a strongly elevated lip on its posterior margin. Anal aperture small. The spinous tubercles small above, much larger on the under surface.

Figures. Natural size.

Discovered first by Mr. A. Scherzer, engineer in charge of the Eastern division of the Costa Rica Railroad, above Paquare, on the Reventazon river. Afterwards found at Sapote.

Descriptions of New Species of Fossils from the Pliocene Clay Beds between Limon and Moen, Costa Rica, together with Notes on previously known Species from there and elsewhere in the Caribbean Area.

By WM. M. GABB.

I HAVE used this rather comprehensive heading for reasons similar to those which prompted a like one for the Miocene fossils. Wherever no special locality is mentioned, it must be understood that the clay beds of the Limon peninsula are meant. Many species are quoted as living on the Cuban coast; doubtless, when the other islands shall have been as thoroughly studied, not only will the geographical range of these be increased, but many species now only known as fossils will make their appearance.

CRUSTACEA.

Crustacean remains are rare in this deposit, but I found one little nodule of clay which disclosed the greater part of a small crab. On attempting to clean it, it crumbled, all but the carapace and left hand, both of which are figured, slightly magnified, on Plate 45, fig. 29.

ATLANTA, Lesueur.

A. AMMONITIFORMIS, Gabb, n. s., Pl. 45, fig. 30.

Shell very minute, dextral, spire well marked and slightly elevated. Dorsum distinctly rounded in the young shell without trace of keel or angle; becoming angulated on the third volution, but bearing no keel or crest. Diameter, 1 mm.

From the Moen beds. Most nearly allied to *A. Peronii*, but differs in the lateral view of the side of the mouth. In that species the outline is a gentle, regular curve; in this, it bends much more backwards towards the peripheral margin.

MUREX, Linn.

M. RECURVIOSTRIS, Brod., P. Z. Soc., 1832, p. 174.

M. nigrescens, Sby., P. Z. S., 1840, p. 138.

Both the above names were given to shells found in the Pacific, and separated on points which seem to be of too little value for specific distinction. Not only am I convinced that our shell belongs to the species, but longer acquaintance with

the fossils leads me to believe that Sowerby's name of *M. Domingensis* (Quart. Journ. Geol. Soc. v. 6, p. 49, Pl. 10, fig. 5) should be added as a synonym. The shells, both recent and fossil, vary considerably in the length, and even in the presence or almost total absence of spines on the varices, and the length and direction of the canal is by no means constant. All three forms are represented by the series before me, as they are also in the Santo Domingo Miocene collection, and specimens sent me by Mr. Guppy, from Trinidad, only serve to confirm my opinion.

M. (CHICOREUS) CALCITRAPA, Lam., A. S. V., v. 9, p. 573.

Fossil from the Miocene; found living in the West Indies, whence it was described by Lamarck, under the name of *brevifrons*.

FUSUS, Lam.

F. HENEKENI, Sby., Q. J. G. S., v. 6, p. 49, Pl. 45, fig. 31.

There is a single specimen in the collection, having all the details of character of the common Sto. Domingo fossil, except that of size, being 5.5 inches long, and 1.5 inches wide. As is usually the case with larger shells, the longitudinal ribs are not clearly defined on the last volution, and the specimen suggests irresistibly a transition to the form of *F. Dupetit-Thouarsii*, of Kiener (Icon. coq. viv., p. 5, Pl. 11), from the Galapagos Islands, and with specimens of which I have compared it. Mr. Guppy's identification of *F. Haitensis* as only a variety of *F. Henekeni* was a fortunate discovery, coming as it did just before the finding by me of this somewhat aberrant form on the main land. Had my shell been picked up on the shores of the Galapagos Islands, or found in a tertiary deposit on the South American Pacific coast, no one would hesitate to call it *F. Dupetit-Thouarsii*. It was found on the Atlantic side, and yet why is it not equally that species? But there are also points of resemblance to the San Domingo shell; and the inference is, that the latter, extinct in Atlantic waters, still exists, and very little modified, except in size, in the Pacific.

MELONGENA, Schum.

M. MELONGENA, Linn., sp.

For remarks on this species, see my Memoir on Santo Domingo, Tr. Amer. Phil. Soc., 1873, p. 205.

TURRIS, Bolt.

T. (DRILLIA) MILITARIS, Hds., sp.

For synonymy see Tr. Am. Phil. Soc., 1874, p. 237.

Fossil in the West Indian Miocene, and living at Panama (Hinds). But a single small specimen occurs in the collection.

METULA, H. and A. Ad.

M. CANCELLATA, Gabb, Pl. 46, fig. 32.

id., Gabb, Memoir on Sto. Domingo, Tr. Amer. Philos. Soc., 1873.

A rare shell in Santo Domingo, whence it was described, it appears here also very rare. It has not been yet found living.

DRILLIA, Gray.

D. MOENENSIS, Gabb, n. s., Pl. 46, fig. 33.

Shell small, robust; spire elevated, longer than the aperture; whorls eight-and-a-half, the upper two-and-a-half being nuclear; suture well marked and bordered on the succeeding whorl by a small rib. Surface ornamented by about eight heavy longitudinal ribs, which barely reach the suture above, and fade out on the body whorl, in front. These are crossed, besides the one thread-like rib bordering the suture, by half-a-dozen similar ribs, three of which are visible on the upper volutions. Directly below the rib bordering the suture, and extending to the shoulder of the whorl, is a space not ribbed, and which corresponds to the sinus of the lip. With a magnifying glass, between the revolving ribs can be seen numerous others, very minute, and which, being crossed by the lines of growth of about equal size, present a finely woven appearance. Aperture contracted, canal short; inner lip heavily encrusted; outer lip thickened; posterior sinus well marked, but not deep.

Figure. Magnified four times natural length.

But two specimens, from the "deep cut," near Moen.

MANGELIA, Leach.

M. ELONGATA, Gabb, Pl. 46, fig. 34.

id., Tr. Amer. Phil. Soc., v. 15.

Described from the Miocene of Santo Domingo; now found near Moen. The specimen figured is the original from Santo Domingo, from which the description was made. The Costa Rican agrees in every respect.

M. SUBCYLINDRICA, Gabb, n. s., Pl. 46, fig. 35.

Shell small, subcylindrical, body whorl constituting about half the length of the shell; spire composed of six whorls, the upper two nuclear and smooth; whorls sloping in so rapidly at the top to the suture as almost to merit the term truncated. Surface ornamented by even, large longitudinal ribs, about nine to a volution, and with deep interspaces; all crossed by numerous small revolving ribs, between which are microscopic revolving lines. Aperture narrow; posterior sinus narrow, deep, and round; outer lip thickened.

Figure. Magnified seven times linear.

From near Moen.

From *M. elevata*, G., Sto. Domingo (fig. 36), of which I give a figure for comparison, it can be distinguished by its more slender form, flatter sides, much narrower and deeper sinus, and by a peculiar difference in the style of the revolving ribs, hard to describe, but very evident when the two shells are placed side by side. In this the ribs look rougher, they are more numerous and more elevated. In the Dominican shell the appearance is rather that of a flat surface on which the ribs are laid. I long considered them the same, but close comparison constrained me to separate them, though perhaps a larger series would again throw them together.

M. LATA, Gabb, n. s., Pl. 46, fig. 37.

Shell small, robust, broad, spire elevated; number of whorls unknown. Whorls convex on the sides, body whorl tapering rapidly and sinuously in front; suture well marked, the top of each whorl rounding in abruptly. Surface marked by about eight slightly sinuous longitudinal ribs with broader concave interspaces. No intermediate sculpture or minute markings of any kind, except half a dozen revolving grooves on the extreme anterior end of the body whorl.

Figure. Magnified between four and five times.

A plain shell with a smooth polished surface, relieved by the large undulating ribs. It is principally remarkable for being the most robust species of the genus yet found in the Caribbean Tertiaries. In size and shape this is near to *M.* ("Pleurot.") *Auberiana*, d'Orb., La Sagra, pl. 25, f. 4-6, but the ribs are more oblique, and this wants the spiral sculpture of that species. I have but a single specimen in which the mouth and whole adjoining surface were apparently injured before fossilization, and then encrusted with parasites. But the surface figured is in good preservation.

From Moen.

TRITONIUM, Link.

T. TRITONIS, Linn. sp.

This well-known shell is represented by a young specimen barely three inches long, and by a perfectly recognizable fragment of another that must have been a foot long when perfect. Both retain traces of color.

T. (CYMATIUM) FEMORALE, Linn. sp. Lam., A. S. V., v. 9, p. 632.

A couple of fine specimens.

T. (LAMPUSIA) LINEATUM, Brod., P. Z. S., 1833, p. 6.

Fossil in the Miocene of Santo Domingo, here again in the Pliocene between

Limon and Moen, Costa Rica, and living on the Gallapagos Islands. A recomparison with reference to the Costa Rican fossil confirms my previous determination.

T. (EPIDROMUS) LANCEOLATUM, Kien.

One beautifully preserved specimen.

DISTORTIO, Bolt.

D. SIMILLIMUS, Sby., sp., Q. J. G. S., v. 6, p. 48.

For synonyms see *Tr. Am. Phil. Soc.*, 1873, p. 212.

Common in the Miocene of Jamaica and Santo Domingo, but not known recent, unless it should prove to be the same with *D. constrictus* of the West Coast, from which it seems to present constant points of difference.

BURSA, Bolt.

B. NANA, Sby., *Conch. Ill.*, fig. 6.

Another Panama species.

B. (LAMPAS) CRUENTATA, Sby. sp., *Conch. Ill.*, fig. 5.

A central Pacific species. This is the shell which I quoted under the incorrect name of "*Trit. commutatum*, Dkr." (*Tr. Am. Phil. Soc.*, 1874, p. 211), following an incorrect label in the museum Phila. Acad. Both the Costa Rican and the Dominican fossils agree perfectly with the description and figures, and with recent specimens in the Academy's museum.

NASSA, Mart.

N. CARIBÆA, Gabb, n. s.

Shell moderate in size, robust; heavily costate; spire elevated; whorls, three nuclear, smooth; seven others, abruptly truncated on top, but not angular; sides convex. Surface marked by large rounded longitudinal ribs, placed a little obliquely and with interspaces equal in size to the ribs; these, about thirteen or fourteen in number, are crossed by numerous small, sharply defined revolving ribs, which are of the same size on the ribs and in the intervening spaces. Mouth two-fifths of the length of the shell, regularly elliptical; callus thin, not much expanded; a single linear tooth posteriorly and a strong fold on the end of the columella; outer lip heavily thickened externally, internally striate; anterior end of the aperture strongly twisted, with the characteristic external groove deeply impressed.

About the size of *N. trivittata*, Say. This species is amply distinguished by its shorter and more robust form, its stronger sculpture and the thickening of the outer lip.

OLIVA, Brug.

O. RECTICULARIS, Lam., A. S. V., v. 10, p. 613.

O. cylindrica, Sby., Q. J. G. S., v. 6, p. 45.

Most of the specimens retain their polished surface and color patterns perfectly preserved, and the present series removes all doubt that I previously had as to the specific identity of the Santo Domingo fossil with the living forms.

O. ISPIDULA, Linn., Syst. Nat., 12 ed., p. 1188.

These olives also retain enough of their color to render certain the determination, based principally on size and figure, notwithstanding the fact that the recent shells are only found in the Eastern seas.

FASCIOLARIA, Lam.

F. TULIPA, Linn. sp., Syst. Nat., Ed. 9, p. 754.

F. distans, Lam., A. S. V., vol. 9, p. 433.

F. semi-striata, Sby., Q. J. G. S., v. 6, p. 49.

F. rhomboidea, Rogers, Tr. Amer. Philos. Soc., v. 6, p. 376, Pl. 30, f. 3.

A widely spread shell, occurring in the miocene of the West Indies and the United States, and yet living on the same coasts. *F. tulipa* and *F. distans* differ only in those characters in which shells are most likely to vary, while in this respect *F. rhomboidea* is intermediate, and on comparing the Costa Rican shells, it is impossible to ally it more with one than another of these forms. In short, the species is the same throughout, as even some of the students of living mollusca are inclined to admit, and as is proven by the older forms. The divergence in the character of the markings seem to have begun in the miocene. In *rhomboidea* the lines are 2.5 mill. apart, in *distans* twice as far, and in *tulipa* close together.

LATIRUS, Montf.

L. INFUNDIBULUM, Gmel. in Lam., A. S. V., v. 9, p. 386.

Fossil in the Miocene, West Indies, and still living on the same coasts.

VASUM, Bolt.

V. MURICATUM, Born. sp. Desh., A. S. V., v. 9, p. 397.

Turb. Haitensis, Sby., Q. J. G. S., v. 6, p. 5a.

V. Haitensis, Gabb, Tr. Amer. Phil. Soc., 1873, p. 218.

In the above quoted memoir I followed Sowerby in separating the fossils from the living form. But from the more recent fossils now before me, I find the suture character, on which I depended, exists in a transitional degree, and the West Indian fossil must be recognized as the lineal ancestor of the recent shell yet common in the West Indies.

VOLUTA, Linn.

V. MUSICA, Linn., Syst. Nat., 12 Ed., p. 1194.

There is an abundant fossil in the deposit corresponding with the recent shell in all of its essential details, except in a persistently narrower mouth. But the fossils differ among themselves in shape and strength of tuberculation, more than they differ from the living shells. I have, therefore, retained the Linnæan name.

MARGINELLA, Lam.

M. AVENA, Val., Kien., Sp. Gen. Coq. Viv., Marginella, p. 17.

A single specimen, agreeing perfectly with the figures and descriptions of this species, as well as with recent examples with which I have compared it. Living throughout the Caribbean province.

M. CHRYSOMELINA, Redf., Ann. N. Y. Lyc., iv. 492, t. 17, f. 2.

Another unique specimen, kindly identified for me by Mr. Redfield. Living, West Indies.

M. MINOR, Adams (C. B.), Ann. N. Y. Lyc., v. 264.

Also identified by Mr. Redfield by comparing with authentic specimens in that gentleman's collection received from the author. Living, Pacific coast.

M. OVULIFORMIS, Gabb, n. s., Pl. 46, fig. 39.

Shell minute, robust; somewhat variable in form from that of a true *Ovula* to a "higher shouldered" variety, where the greatest width being nearer the upper end, it approximates more nearly to the typical shape of the genus. This variation is very slight, however, and I have selected my most *Ovula*-like specimen for illustration. In perfectly adult specimens the spire is entirely hidden by the heavy outer lip. Aperture curved; outer lip crenulated, bearing three prominent folds below the middle, the columella ending in a fourth, stronger than the others, which is continued around the anterior end of the mouth and merges into the outer lip. Surface polished.

Length $1\frac{1}{2}$ mm.

The hidden spire, the anterior notch nearly obsolete and bordered by a thickened rim, and the general shape seems to ally this little shell to the subgenus *Volutella* of Swainson.

COLUMBELLA, Lam.

C. VARIA, Sby., Thes. Conch., t. 39, f. 116, 117.

A common Panama species. My specimens are small, but not remarkably so, and except that they are a very little more slender than the recent shells there are no points of difference.

STROMBINA, Mörch.

S. LIMONENSIS, Gabb, n. s., Pl. 46, fig. 40.

Shell minute, robust, spire elevated, as long as the mouth; whorls eight, sides nearly flat, very gently convex and sloping regularly outwards; suture incised; surface perfectly plain, except on the canal and extreme anterior part of the body volution where there are half a dozen impressed obliquely revolving lines. Aperture not very broad; outer lip deeply notched, below which it is very thick; ridged internally; inner lip not heavily encrusted.

Length 3 mm.

The figure is inaccurate in the columellar region. The anterior part is drawn straight and narrow, whereas it should encroach much more on the mouth in its anterior third, below which the columellar margin should slope backwards to the end of the canal. For the anterior two-thirds of the mouth the columella should be nearly a third wider, encroaching that much more on the aperture.

S. EXILIS, Gabb, n. s., Pl. 46, fig. 41.

Shell small, narrow fusiform; spire high; whorls eight and a half, including the nucleus, smooth, convex; suture well marked; body whorl marked by a few revolving lines on the anterior half; aperture one-half the length of the shell; narrow, produced in front into a broad, slightly recurved canal; inner lip lightly encrusted; outer lip thickened and internally toothed.

Somewhat smaller than *S. bicanaliculata*, this plain little shell can be at once distinguished by the absence of the great posterior canal. The outer lip is the least thickened of any species of the genus known to me, and in this character, as well as in the absence of all tuberculation, the shell shows an approach to the genus *Amycla*.

CASSIS, Lam.

C. FLAMMEA, Lam., A. S. V. (Desh. Ed.), v. 10, p. 22.

The common large West Indian shell is represented by one large characteristic specimen.

CASSIDEA, Brug.

C. GRANULOSA, Brug., Enc. Meth., v. 1, p. 421.

Common in the West Indies, both recent and fossil.

CASSIDARIA, Lam.

C. LÆVIGATA, Sby., Q. J. G. S., v. 6, p. 47, Pl. 10, fig. 2.

C. SUBLÆVIGATA, Guppy, *loc. cit.*, v. 22, p. 287, Pl. 17, f. 10.

The Costa Rican specimens, in their greater amount of striation, are nearer to

Mr. Guppy's form than to the original described by Sowerby. This character approaches then to *C. striata*, Lam., which only differs from the present form in being a little higher in the spire and still a little more strongly striated.

We have in this group a beautiful illustration of development. The oldest known forms of the shell, those of the Santo Domingo Miocene, are polished in the adult state; the spire is always striated, and the markings when they exist on the body whorl are so nearly obsolete as not to interfere with the generally polished surface. The varices, three in number, are well marked on the adult. The outer lip is usually expanded posteriorly and laterally so as to cause a false appearance of a low spire; and the markings on the inner lip are somewhat obsolete. In the same formation in Jamaica the shell occurs, here retaining the juvenile character of the striated surface over the body whorl, depriving it of its polished appearance; and with this tendency to a sculptured surface, there is a nearly total disappearance of the varices and an increase also of the size of the corrugation on the inner lip. Still further west, and at a later period, we find the shell, yet abundant, becoming more slender and especially diminishing the posterior expansion of the outer lip, and with the sculpture character further developed. And finally, the recent *C. striata*, no doubt the lineal descendant of the above, is yet more slender, the outer lip more sloping posteriorly, the spire only a trifle higher, and the surface markings but a little more intensified! Reeve says he can obtain no information as to the locality of the recent shell. The specimens in the museum of the Philadelphia Academy are also without a locality label, but no doubt, from the foregoing, the species will prove to be either from the Caribbean or the Panama province.

MORUM, Bolt.

M. ONISCUS, Linn., Sp., H. and A. Ad., Gen., v. 1, p. 219.

Not common. I found but a single specimen.

NATICA, Linn.

N. CANRENA, Linn., Mus., p. 674.

Abundant.

MAMILLA, Schum.

M. MAMILLARIS, Lam., Sp., A. S. V., v. 8, p. 628.

Abundant.

SCALARIA, Lam.

S. CANDEANA, d'Orb., La Sagra, vol. 2, p. 20, Pl. 11, figs. 28-30.

A shell recent on the coast of Cuba, now found fossil for the first time, in the clay beds of the Limon peninsula.

S. LEROYI, Guppy, Tr. Sci. Soc., Trinidad, 1867, p. 168.

id., Guppy, Geol. Mag., 1874, Pl. 16, fig. 10; Pl. 18, fig. 2.

Very rare. Described from the Miocene of Jamaica, not yet found in Santo Domingo, nor yet living. I was fortunate enough to procure a couple, one in fair condition, from the Moen clay beds.

RINGICULA, Desh.

R. SEMISTRATA, d'Orb., La Sagra, v. 2, p. 103, Pl. 21, figs. 17-19.

Fossil in the Miocene of Santo Domingo, in the Pliocene, Costa Rica, and originally described from living specimens from the Cuban coast.

TURBONILLA, Risso.

T. TURRIS, d'Orb., Sp.

Chemnitzia, *id.*, d'Orb., Amer. Merid., Moll., 396.

id., d'Orb., La Sagra, v. 1, p. 219, Pl. 16, figs. 10-13.

A single specimen, but as in life. Living on the Cuban coast.

ACLIS, Loven.

A. MICROSCULPTA, Gabb, n. s., Pl. 46, fig. 42.

Shell very minute, slender, many whorled, spire long and narrow; whorls about ten; the upper two nuclear, smooth and dextral; suture deep but small; whorls very convex on the sides, plain for a very narrow space adjoining the suture, below which space is a rib large enough to make a minute break or angle on the side of the whorl; below this are about seven or eight very small revolving ribs, only visible under a strong lens. Aperture nearly circular; outer lip acute, sinuous, emarginate near the suture and prominent on the middle and lower part of the whorl. Inner lip slightly thickened. Umbilicus imperforate.

Length nearly 2 mm.

Of about the same size as d'Orbigny's "*Chemnitzia*" *simplex*, it differs in the whorls being more convex and more numerous, the mouth also being shorter and the shell more slender. From "*C.*" *laevigata*, d'Orb., it can be distinguished by its more slender form and by its more numerous and more convex whorls.

EULIMA, Riss.

E. CRASSILABRIS, Gabb, Pl. 46, fig. 43.

id., G., Memoir Sto. Domingo, Tr. Amer. Phil. Soc., v. 15, p.

Originally described from Santo Domingo; the specimen figured is from the Moen clay beds.

E. SUBCARINATA, Orb. (Cuba, I., 217, t. 16, figs. 4-6), Pl. 46, fig. 44.

Limon, C. R.

ARCHITECTONICA, Bolt.

A. BISULCATA, d'Orb., sp.

Solarium, *id.*, d'Orb., La Sagra, p. 66, Pl. 18, figs. 17-20.

A single, but very well preserved specimen. Found living on the Cuban coast.

A. GRANULATA, Lam., A. S. V., v. 7, 3.

S. quadriseriatum, Sby., Q. J. G. S., v. 6, p. 51, Pl. 10, fig. 8.

Further comparisons of large suites of both recent and fossil specimens, including some from Costa Rica, convince me of the identity of the fossil and recent shells.

CONUS, Linn.

C. LEONINUS, Hwass, Encyc. Meth., v. 1, Part 2, p. 683, Pl. 334, figs. 5-6.

Half a dozen specimens, all retaining their color pattern. A well known West Indian shell.

C. CONSOBRINUS, Sby., Q. J. G. S., v. 6, p. 45.

C. granozonatus, Guppy, *loc. cit.*, v. 22, p. 287, Pl. 16, fig. 5.

Two or three of the specimens retain traces of coloration; the pattern resembling that of *C. Haitensis*, a dark ground, irregularly streaked and flaked with white, the light color being arranged more or less spirally. I am in some doubt as to whether this is really the remains of the color of the live shell, or whether it may not be connected with some peculiar condition of fossilization.

The species is found fossil in Jamaica and Santo Domingo. It is not known living.

C. REGULARIS, Sby. (Conch. Ill.), Pl. 46, figs. 45-48.

An abundant fossil of Costa Rica which agrees with the descriptions and figures as well as with recent specimens from the Gulf of Nicoya, except that the surface is described as smooth. I find, however, that some of the recent shells are grooved and even marked by moniliform ribs, especially on the anterior end. The fossils vary from more nearly smooth than some of the recent specimens, to a form covered over the entire surface with large ribs, with equal, deep interspaces. *C. marginatus*, Sby. (fossil in Santo Domingo), seems to be only an older form of the same species. It is smaller and more robust than the recent shell, though approached in this respect by some of the Costa Rican fossils. Its surface is regularly marked by square revolving ribs, with equal squarely sunken interspaces, and even this character is approached by some of the specimens before us.

STROMBUS, Linn.

S. BITUBERCULATUS, Lam., A. S. V. (Desh. Ed.), V. 9, 690.

Not rare.

S. PUGILIS, Linn., Syst. Nat. (12 Ed.), p. 1209.

CYPRÆA, Linn.

C. CINEREA, Gmel., Syst. Nat., p. 3402.

Very common. Living now in the West Indies.

C. CARNEOLA, Linn., Syst. Nat., 1174.

My friend Mr. Roberts, who has probably paid more attention to this genus than anybody else in Philadelphia, kindly assisted me in identifying these Cypræas. Despite the absence of color, the most important specific character here, I am satisfied that the determinations are correct. Now living in the Pacific. Abundant also in the deep railroad cutting so often mentioned.

TRIVIA, Gray.

T. PEDICULUS, Linn., Syst. Nat. (12 Ed.), p. 1180.

CYPHOMA, Bolt.

C. GIBBOSA, Linn.

Bulla gibbosa, Linn., Syst. Nat., p. 1183.

Ovula id., Lam., A. S. Vert.

But two specimens were found; the polish is as perfectly preserved as in life.

CERITHIUM, Brug.

C. MOENENSIS, Gabb., n. s., Pl. 46, fig. 49.

Shell subulate, robust, spire high, whorls numerous; suture impressed, irregular. Surface marked by from eight to ten large irregular nodes on the upper part of each whorl adjoining the suture, making the suture undulated and extending as ribs over the upper whorls. On the body volution these tubercles disappear about the middle. On the same volution, near the inner lip, is a varix-like thickening, prolonged with the canal; over the whole surface are small, closely placed, and numerous revolving lines. Aperture rounded, constricted both above and below; canal narrow, short, and sharply deflected. Inner lip thickened, bearing a strong posterior tooth and ending in a sharp fold which extends to the end of the canal; outer lip acute, projecting below, and finely striated internally.

Nearest to *C. Guinaicum*, Phil., as figured by Sowerby, Thesaurus, Pl. 181, fig. 127, but is more slender, higher, the outer lip less produced anteriorly, has a

more prolonged canal, and a smaller tooth on the inner lip. It is entirely unlike any species known to me from the Caribbean region, either fossil or recent.

C. BISERIATUM, Gabb, n. s., Pl. 46, fig. 50.

Shell minute, spire elevated, sides flat, whorls numerous; each one ornamented above by two strong beaded ribs placed close together, and on the lower part of the whorl by two more distantly placed plain ribs. The lower of these forms the lower angle of the volution, and the upper of the two beaded ribs of the succeeding whorl is placed on its periphery, so that the suture appears to be on the upper surface of the beaded rib. Mouth small, the inner face of the outer lip ribbed; a heavy rib on the base of the shell, another on the middle of the columella, and two or three fainter, twisted folds in advance.

Figure. Highly magnified; actual length 5 mm.

C. LIMONENSIS, Gabb, n. s., Pl. 46, fig. 51.

Shell minute, elongated, slender, spire very elevated, sides slightly convex, as are also the sides of the individual whorls. Volutions twelve, of which the first four are nuclear and smooth. The others are ornamented by a series of longitudinal and revolving ribs of about equal size so as to produce a decided clathrate appearance of the surface. Of the revolving ribs there are three to a volution. Aperture broad; columella encrusted, twisted, and bearing but one faint fold in advance. Actual size 4 mm.

Figures. Magnified a little over five lengths.

C. CARIBBÆUM, Gabb, n. s., Pl. 46, fig. 52.

Shell small, very elongated, increasing so slowly in diameter as to be almost sub-cylindrical. Surface flat on the sides; each whorl bears two large beaded ribs, or what might be better described as two rows of large rounded tubercles; these are connected by elevated ridges both laterally and longitudinally, and close below the upper one, on the longitudinal connections, is a series much smaller. The lower angle of the whorl carries a plain rib, on the under and outer face of which is the suture. Mouth small; columella carrying a couple of oblique folds in advance.

Fragment figured 5 mm. in length; with the missing part of the apex it must have been $7\frac{1}{2}$ to 8 mm. Although both this and *C. biseriatum* are characterized each by two heavily beaded ribs, their manner of disposition, and the supplementary ornaments serve sufficiently to distinguish them, as well as do the details of the mouths. A glance at the figures renders confusion impossible.

C. TRISERIALE, Gabb, n. s., Pl. 46, fig. 53.

Shell minute, spire elevated, whorls increasing gradually in size, nine in number, of which three are nuclear; the others slightly convex and sloping on the sides, and most prominent below, curving in rather rapidly to the suture, which is contained between two plain thread-like ribs. The rest of the surface is cancellated by a series of three revolving ribs, crossing a series of longitudinal ones of equal size, and producing an appearance of tuberculation at each point of intersection. Aperture broad, elongated, outer lip simple; inner lip lightly encrusted; columella slightly bent, produced, but bearing no folds. Length 3 mm.

Sufficiently like *C. Limonensis* to render a little care necessary in distinguishing such minute objects. This is a much broader and more robust shell, has but nine volutions, while that has twelve; this has three whorls in the nucleus, that has four; the suture of this is distinctly pointed out by the plain ribs that border it, while in that the suture is lost sight of in the strong cancellation of the surface. In this the mouth is much larger and the canal more produced than in that.

C. COLLINSII, Gabb, n. s., Pl. 46, fig. 54.

Shell small, elongated, spire high, apical angle rather broad; whorls nine, two of which form the smooth nucleus; the other seven convex on the side, and ornamented by fine, thread-like, revolving, and longitudinal ribs which cross each other without tubercles, or other increase in size, forming a regular fenestration. Of the revolving ribs there are three on the body whorl, but only two on the upper volutions. Base of body whorl plain or carrying a single thread-like rib. Aperture broad; outer lip simple; inner lip faintly encrusted; columella small, faintly twisted, and without a fold.

Length 5 mm.

Named after Mr. Collins, my topographical assistant.

C. LORDLYI, Gabb, n. s., Pl. 46, fig. 55.

Shell minute, subulate, whorls seven, barely an entire one at the apex being smooth; lower whorls slightly convex; suture well marked; surface ornamented by about ten or a dozen longitudinal ribs, crossed by three smaller revolving ribs. On the body whorl there is a fourth of these ribs, besides another heavy plain rib, which borders the plain base of the whorl. This last rib winds into the aperture so as to produce the false appearance of a posterior tooth on the pillar lip. Occasionally one of the longitudinal ribs increases so in size as to develop almost into a varix for a single volution. Mouth subquadrate; inner lip slightly encrusted and reflected; columella straight, slightly everted, but without fold.

Length 3 mm.

BITTIUM, Leach.

B. MODESTUM, Orb. 46, fig. 56.

Chemnitzia id., Orb., Moll. Cuba, I. 222, t. 16, figs. 22-24.

B. DUBIUM, Orb. 46, fig. 57.

Chemnitzia id., Orb., Moll. Cuba, I. 226, t. 17, figs. 4-6.

TRIFORIS, Desh.

T. TURRIS-THOMÆ, Chemn. sp.

Turbo id., Chemn., Conch. Cab., t. XI, pp. 310, 213, No. 3022.

Cerithium id., d'Orb., La Sagra, p. 155, Pl. 33, figs. 10-12.

Comparatively common. Living in the West Indies.

MODULUS, Gray.

M. CATENULATUS, Küst., sp.

Trochus id., K., Syst. Conch., p. 110, Pl. 18, fig. 4.

Modulus id., H. & A. Ad., Gen. Rec. Moll.

A single specimen. Species living, Pacific coast.

RISSOA, Frem.

R. AUBERIANA, d'Orb., La Sagra, vol. 2, p. 22, Pl. 11, figs. 34, 35.

Three good characteristic specimens. Yet living; coast of Cuba.

CAECUM, Flem.

C. CRASSICOSTUM, Gabb, n. s., Pl. 46, fig. 58.

Shell curved, a little more abruptly at the apex than elsewhere; ornamented by large, round ribs, the interspaces being a very little narrower than the ribs. In the interspaces are minute ridges placed in a longitudinal direction, as if they were the rudiments of fine longitudinal ribs, which, however, do not rise over the larger ones; or they might be described as a series of regularly placed narrow septa between deep pits; since their presence produces an appearance of pitting in the grooves, similar to that seen in some of the *Actæons*. The transverse ribs are nearly of uniform size, except the last three or four, which are slightly larger and placed more widely apart.

Length 3 mm.

C. ANNULATUM, Gabb, Pl. 46, fig. 59.

id., Gabb, Tr. Amer. Philos. Soc., vol. 15.

A Dominican species, not yet found elsewhere; figured here for purposes of comparison.

VERMETUS, Auct., Cuv.

V. LUMBRICALIS, Linn., Mart., Conch. I, t. 3, f. 246.

A few small fragments, but enough to identify the species with certainty.

SILICUARIA, Brug., *not Schum.**(Agathirses, Montf., Tenagoda, Auct.)**S. SCULPTURATA*, n. s., Pl. 46, fig. 59a.

Shell large, beginning in a loose, irregular spiral, until it acquires a diameter of about one inch, when it runs off in a much more open and direct spiral, several inches in length, and somewhat over an inch in diameter. Surface marked by numerous, closely placed, longitudinal ribs, crossed by lines of growth, some of which rise as sub-squamose plates on crossing the longitudinal ribs, giving the entire surface the roughened appearance of a rasp. This is most marked on the under side. Cross section circular; aperture elongate, the sides sloping upwards and backwards to the superior slit, the lower margin of the lip produced and thin.

The two species nearest to this are the recent *S. centiquadrata*, marked by about the same number of longitudinal ribs, but entirely wanting the rasp-like cross sculpture, and the Eocene species, described by Mr. Lea under the name of *S. Claibornensis*, from Alabama, which is smaller, more regular in its juvenile mode of growth, and entirely different in style of ornament.

As is the case with many, if not all of the *Vermetidæ*, as this species increased in size, the animal withdrew itself from the older parts of the tube, closing the slit by a deposit of shell matter on the inside, and building one septum after another at irregular distances.

GENUS INDET.

Two fragments of irregularly contorted tubes, each nearly an inch long; not referable to either of the preceding species.

XYLOPHORA, Fisch.

X. AGGLUTINANS, Lam., sp.*Trochus id.*, Lam., A. S. V., 1 Ed., v. 7, p. 558.

Not common.

HIPPONYX, Defr.

? *H. CREPIDULA*, Gabb, n. s., Pl. 46, fig. 60.

A little compressed, curved, and equilateral shell, which I refer doubtfully to *Hipponyx*, because I have not been able, with the greatest care, to detect any muscular scar. In the median line is a marked depression, which even shows some traces on the inner surface. The mouth is subquadrate, or rather pentagonal, from the median prolongation. The apex minute and incurved, but without the slightest trace of a spiral. Lines of growth regular, except one or two a little

stronger than the others. A rather sharp angle runs on each side from the apex, bordering the dorsal surface, ending abruptly against the outer posterior angle of the aperture. Borders of the mouth roughened by irregular lines of growth.

Length 3 mm.

There being but one specimen of this shell in the collection, and these forms being very variable, often depending for their shape on the character of the surface to which they are attached, I feel reluctant in giving a specific description; not doubting but that the next specimen may be of a very different form. Nevertheless it is important that all the organic remains in these rocks be made known, even if imperfectly, so as to enable us to arrive at the more important geological results.

ADEORBIS, S. Wood.

A. SIMPLEX, Gabb, n. s., Pl. 46, fig. 61.

Shell minute, discoidal, flattened, whorls four, nearly flat on top, bending down slightly to the suture; base a little more convex, periphery regularly and narrowly rounded; umbilicus broad; surface smooth. Mouth a little wider than high; outer lip sinuous.

Figure magnified ten diameters.

A perfectly plain, unornamented little shell, unlike, in this respect, all the others of similar form or size with which it is associated.

A. INFRACARINATA, Gabb, n. s., Pl. 46, fig. 62.

Shell minute, discoidal; spire slightly elevated; whorls three to three and a half, convex on top; suture nearly obsolete; periphery bearing a strong rib, below which, on the under surface of the whorl, are three more; the innermost forming a faint margin to the umbilicus, and being placed on the middle of the base. Umbilicus broad and deep, showing all the whorls. Mouth oblique.

Smaller than the preceding shell, this cannot be confounded with it, even in the top view, where they resemble each other in being smooth. In that, the suture is very distinct; in this it is faintly marked.

The figure is magnified twelve diameters.

I have tried to identify this shell with Guppy's *Vitrinella marginata*. His description gives no idea of the size, and his figure must therefore be taken as the only clue we have. My species is $1\frac{1}{2}$ mm. in diameter, while his figure is over 6. They agree in having four ribs, invisible from above; but from Guppy's figures, these ribs seem to be confined to the periphery, and do not reach the under surface. But, on the whole, the figure quoted is so very imperfect that very little can be learned from it.

CALLIOSTOMA, Sw.

*(Zizyphinus, Gray.)**C. GUPPYANA*, Gabb, n. s., Pl. 46, fig. 63.

Shell small, conical; spire elevated; whorls eight or nine; the first one, or one and a half nuclear and unornamented. Suture hardly distinguishable among the numerous ribs. Sides of the whorls regularly sloping, so that the whole apical slope is a straight line. Surface of each whorl ornamented by four large beaded ribs, one placed at the extreme upper margin, two close together below, and the fourth about half way between the upper of these two and the top rib. The two upper ribs are accompanied on the body whorl, each by a smaller one, placed a small distance below it, and all the beading on all these ribs is placed along the lines of growth and connected by small raised lines. The outer basal angle of the body whorl is acute; the under surface flat to concave, and ornamented by many small revolving ribs.

Height of shell 5 mm.

GIBBULA, Risso.

G. TUBERCULOSA, d'Orb, sp.*Delphinula id.*, d'Orb, La Sagra, vol. 2, p. 69, Pl. 19, figs. 28-30.

MARGARITA, Leach.

M. TRICARINATA, Gabb, Pl. 46, fig. 64.

Shell small, robust, spire elevated, whorls four—the one at the apex round, the others angulated and ornamented. Top of the whorls sloping, sides flat and vertical. Suture impressed and bordered by the strongly crenulated margin of the succeeding whorl. Top of whorl between this margin and the outer angle either plain or carrying one or more small ribs. Periphery of whorl carrying three strong crenulated ribs, the interspaces either perfectly plain or with faint interpolated ribs; all this covered with very minute lines of growth. Under surface also variable. In one case before me it is perfectly plain; in another it is closely covered with minute, revolving, beaded ribs. The umbilicus varies greatly in diameter, is invariably bordered by a crenulated angle, the crenulation fine or coarse according to variation; and half way up on the whorl it carries a strong, spiral, revolving rib.

Average height $2\frac{1}{2}$ mm.

First rather imperfectly described from Santo Domingo, but now that I have a fine series from Costa Rica showing all the above, and even other minor variations, I have availed myself of the opportunity of redescribing it.

VITRINELLA, C. B. Adams.

V. PARVA, C. B. Ad., Cab. Panama Shells, 187.

I have identified the Costa Rican fossil by direct comparison with authentic specimens, presented by Adams to the museum of the Philadelphia Academy. The shell is now living in the Pacific, Mazatlan to Panama.

V. TRUNCATA, Gabb, n. s., Pl. 47, fig. 65.

Shell minute, discoidal, whorls four; the top abruptly flattened, so that the spire is not visible from a top view; the flattening being bordered by a sharp angle below which the side of the shell expands convexly, and continues with a gentle curve to the angular margin of the umbilicus. Umbilicus very broad and bordered by an angle similar to, but not so marked as that on the upper margin. Entire surface, including that of the umbilicus, covered with minute revolving lines; these are crossed on the outer side of the whorl by lines of growth.

Diameter between 1 and $1\frac{1}{2}$ mm.

The angular top and the spiral lines running in true spiral, and not obliquely, will distinguish this from the following species.

V. OBLIQUESTRIATA, Gabb, n. s., Pl. 47, fig. 66.

Shell minute, flattened above; spire low; whorls four, slightly convex on their upper surfaces, rounding down to the suture. On top of the body whorl, a little removed from its inner edge, is a slight depression; sides convex; base sloping convexly to the umbilical border. Umbilicus moderately broad, deep, showing all the volutions. Mouth nearly round; inner lip slightly thickened. Surface, besides a few lines of growth, marked by minute revolving striæ. Some of these, on the upper surface, begin at the suture, and diverge at a small angle, thus throwing out the striation of the top of the whorls obliquely.

Diameter 2 mm.

The higher shell and the absence of the angular top, as stated above, are sufficient diagnostic characters.

V. CRASSICOSTA, Gabb, n. s., Pl. 47, fig. 67.

Shell very minute, flattened above so that the apex cannot be seen from a lateral view; whorls three or four; suture pronounced and bordered in the larger whorls by a slightly crenulated border; top of whorl undulated; convex for the inner half, concave on the outer half, and ending in an elevated angle, which forms the upper of three large ribs on the vertical side of the whorl. Base of whorl equally divided by a prominent revolving angle, outside of which it slopes

upwards and outwards to the peripheral margin, and inside of which it falls into the broad deep umbilicus. Mouth nearly round; inner lip slightly thickened.

Diameter 1 mm.

Its minute size, square form, and strong ribs sufficiently distinguish this shell from its congeners.

V. PENTAGONA, Gabb, Pl. 47, fig. 68.

Cyclostrema id., St. Domingo Memoir, Trans. Amer. Phil. Soc., v. 15, p.

I figure this Santo Domingo species merely for comparison with the Costa Rican forms. It has not yet been found outside of Santo Domingo.

PARKERIA, N. Gen.

Shell minute, in form like *Rotella* (*Umbonium*), but with the shell substance vitreous and transparent or translucent like *Vitrinella*. Inner lip thickened, and the umbilicus covered with a not very heavy callus, as in *Rotella*.

The peculiarities of this genus are that all the known species are of this minute size. In shape all could go well into *Rotella*, but the vitreous shell structure forbids it. I have serious doubts as to the propriety of placing this genus next to *Vitrinella*, despite the structure, and strongly suspect that when the animals shall have been examined, it will be found to be more nearly allied to *Rotella*. Named after my friend Mr. C. F. Parker, Curator of the Academy of Natural Sciences of Philadelphia.

P. VITREA, Gabb, Pl. 47, fig. 69.

Umbonium vitreum, Gabb, Tr. Amer. Phil. Soc., v. 15, p.

This species may be taken as the type of the genus. It has not yet been found outside of the Santo Domingo Miocene.

P. DIAPHANA, d'Orb, sp.

Rotella diaphana, d'Orb, La Sagra., vol. 2, p. 62, Pl. 10, f. 20-22.

Another species of the new genus. Living on the coast of Cuba, and fossil in Costa Rica.

I think it is very probable that *R. semi-striata*, d'Orb., *loc. cit.*, belongs to this same genus, but know it only from the published figures.

P. INCONSPICUA, Gabb, n. s., Pl. 47, fig. 70.

Shell very small, vitreous, translucent, laterally expanded; spire low, whorls four, convex, tops slightly sloping; side of whorl round; base gently concave; mouth nearly round, a little oblique; inner lip thickened, encrusting the body whorl, but not expanded beyond the mouth, anteriorly it continues thick until it

merges into the lip in front. Umbilical region covered with an unusually thin layer of enamel.

Diameter barely 1 mm.

From the Dominican species it can be distinguished by its constantly smaller size, flatter shape, and in the fact that the umbilical callus and adjoining inner lip are much lighter and thinner.

FISSURELLA, Brug.

F. NODOSA, Born. Mus. 426.

Two good specimens. Living in the West Indies.

LUCAPINA, Gray.

L. ALTERNATA, Say, sp., Journ. Phil. Acad., 1 ser., v. 2, p. 224.

Fossil in the Miocene of Santo Domingo. Living in the West Indies and on the Atlantic coast of the United States.

DENTALIUM, Linn.

D. DENTALE, Linn. (?) Born. Mus. t. 18, fig. 13.

I refer two fragmentary specimens to the Linnæan species with some doubt, but with such imperfect material cannot be more certain. They agree in size and amount of curvature with Sowerby's figure in Thes. Conch., but are not only not twelve costate, but differ between themselves in this variable and unreliable character. The largest has about thirty ribs, which show a marked tendency to alternation in size, every other one being larger, thus reducing the larger ribs to an approximation to the required number. The smaller specimen is much more finely sculptured, and the ribs are markedly uniform in size.

CYLICHNA, Loven.

C. SULCATA, d'Orb. sp.

Bulla id., d'Orb., La Sagra, v. 1, p. 129, Pl. 4 bis, f. 9-12.

Cylichna id., Gabb, St.-Domingo Memoir, Tr. Am. Phil. Soc., v. 15.

Fossil in Santo Domingo, living on the Cuban coast, and now fossil in Costa Rica.

TORNATINA, A. Ad.

T. RECTA, d'Orb. sp.

Bulla recta, d'Orb., La Sagra, Pl. 4 bis, figs. 17-20.

Tornatina id., Gabb, Mem. Tr. A. P. S., v. 15.

The same remarks apply here as to the *Cylichna*. In the above quoted memoir, among hundreds of typographical errors, the printers made this genus *Tomatina*. The paper was printed during my absence in Costa Rica.

VOLVULA, A. Ad.

V. ACUTA, d'Orb. sp.

Bulla id., d'Orb., La Sagra, Pl. 4 (not 4 bis), figs. 17-20.

I found an allied species to this in Santo Domingo, which I called *cylindrica*. The present is the first time that *acuta* is reported fossil.

BULLA, Linn.

B. STRIATA, Brug., Enc. Meth., p. 372.

Not rare, but the specimens are always small; the largest being less than an inch in length.

OPERCULATUM, Linn.

O. INDICUM, Linn., Gmel. (sp.), p. 3720.

Not rare; but difficult to preserve from being extremely fragile.

MARTESIA, Leach.

M. STRIATA, Linn. sp., Syst. Nat., p. 1111.

But a single specimen, in good condition however, with the valves together, and perfectly recognizable.

TAGELUS, Gray.

(*Siliquaria Schum.*, not Brug.)

T. LINEATUS, n. s., Pl. 47, fig. 71.

Shell thin, elongate subquadrate, ends rounded, base nearly straight or very slightly concave; beaks placed about a third of the length from the anterior end. Surface posterior to the beaks crossed by a series of fine lines, imbricated, and irregular, but subparallel. These lines begin at the cardinal margin, inclined strongly forward and change their direction on the convex surface, which extends from the beaks to the posterior basal angle, becoming more transverse but not reaching the basal edge. They do not occur in advance of the beaks, and on some specimens cover but a part of the area above indicated.

T. lineatus is nearest to *T. gibba*, Spengler, but differs in the posterior end being more regularly convex, in the beaks being more anterior, in the whole shell being shorter and broader, and in the surface markings. In this latter character it is very much like *Macha candida*, Rinieri, but the lines do not extend so far forward as in that species.

CORBULA, Brug.

C. CONTRACTA, Say, Journ. Phil. Acad., 1 ser., v. 2, p. 312.

Fossil in Costa Rica, and common, living on the coast of the United States. Found also in the Dominican Miocene.

C. DISPARILIS, d'Orb., *La Sagra*, v. 2, p. 283, Pl. 27, f. 1-4.

C. vieta, Guppy, *Quart. Journ. Geol. Soc.*, v. 22, p. 580, Pl. 26, f. 8.

Although Mr. Guppy is loth to yield his name as a synonym (see *Quart. Journ. Geol. Soc.*, 1876), still I did not make the determination without due consideration, and a review of the question only confirms my opinion. As Mr. Guppy says, his shell is found in the Eocene, Miocene, and Pliocene of the West Indies, and we now have it on the main land.

C. LAVALEANA, d'Orb., *La Sagra*, vol. 2, p. 284, Pl. 27, f. 9-12.

Not rare in Costa Rica. Abundant in Santo Domingo, and living on the Cuban and doubtless also on the Dominican coast.

TELLINA, Linn.

T. (PERONÆODERMA) ALTERNATA, Say, *Journ. Acad. Phil.*, v. 2, p. 275.

Another species from the coast of the United States.

T. (ANGULUS) POLITA, Say, *loc. cit.*, p. 276.

Also from the North American coast.

T. (PERONÆA) APPRESSA, n. s.

Shell flattened, elongate; beaks subcentral, very slightly in advance of the middle; cardinal margin regularly but very slightly convex from the beaks and sloping gently to the posterior end, excavated and sloping in advance; anterior end produced and subtruncated, not angular; base broadly and regularly convex. Surface marked only by lines of growth.

Length from 1 inch to $1\frac{1}{4}$ inch.

Most closely related to *T. rufescens*, Chemn., but differs in the regular convexity behind the beaks; the base is also regularly rounded instead of being slightly sinuated in advance, and the anterior end is broader and more squarely truncated.

DONAX, Linn.

D. MOENENSIS, Gabb, n. s., Pl. 47, fig. 72.

Shell small, inequilateral, rounded triangular, beaks about two-fifths of the length of the shell from the anterior end, which is broadly rounded below, nearly straight above. Posterior cardinal margin straight, and sloping gently to the narrowly rounded posterior end; base broadly and regularly convex. Surface ornamented by radiating lines, more or less visible, in different individuals, to the anterior margin, always obsolete on the posterior part of the shell, but well developed on the angle running from the umbones to the anterior basal angle. Internal margin crenulated.

Length, $3\frac{1}{2}$ mm.

This shell belongs to the most typical form of the genus, that of *D. denticulatus*. The series contains specimens of both valves, showing the hinge perfectly. Not common.

SEMELE, Schum.

S. VARIEGATUM, Lam., sp.

Tellina id., Lam., A. S. V., v. 5, p. 490.

Semele id., Tryon, Journ. Conch., vol. 4, p. 122.

Only distinguishable from recent specimens from the coast of Brazil, in being a little thinner, and in some unimportant details of sculpture not of specific value.

VENUS, Linn.

V. RUGOSA, Gmel., Syst. Nat., p. 3276.

Common, both living in the West Indies, and fossil.

V. PAPHIA, Linn., Syst. Nat., p. 1129.

Like the preceding, found common in the West Indian waters.

CALLISTA, Poli.

C. MACULATA, Linn., sp., Syst. Nat., p. 1132.

The broad form of this common species is one of the most abundant fossils in the deposit. Associated with this is another form, having all of the specific characters of *maculata*, except that it is regularly sloping posteriorly from the beak, so that the posterior cardinal margin is a nearly straight line, instead of being distinctly *humped*. The colors are retained on one or two specimens, and consist of two broad bands of irregular spots radiating downwards and backwards from the beak, in the same manner as two similar bands occur on some specimens of the living *C. maculata*. The difference in form would be amply sufficient to divide the fossils into two well-marked species, but there are specimens of *C. maculata* from the West Indies in the museum of the Philadelphia Academy of Natural Sciences which nearly, if not perfectly, connect the two forms. For the cuneate form I propose the varietal name of *cuneata*.

"*Cytherea*" *planivieta*, Guppy, is intermediate between the two in form, but can be at once distinguished by its strong concentric ribs.

MERETRIX, Lam.

? *M. DISCOIDEA*, n. s., Pl. 47, fig. 75.

Shell small, nearly equilateral, length and width about equal, rounded subquadrate; beaks central; lunule obsolete, surface marked only by striæ of growth.

Diameter about half an inch.

This little shell is common in the clay beds, but, unlike most of the other fossils, the inclosed matrix is very hard, and so firmly cements the two valves together that even by destroying one or several shells, I have been unable to make out all of the details of the hinge. What I have seen seems most like that of *meretrix*, but the reference is rendered somewhat doubtful by the absence of a lunule. The shell can be recognized by its small size, its compressed sides and its subquadrate, or rather subpentagonal form.

PSEPHIS, Cpr.

P. CANCELLATA, n. s., Pl. 47, fig. 74.

Shell small, subtrigonal, compact; beaks acute and prominent, base regularly rounded; surface marked by fine concentric ribs, crossed by others of an equal size radiating from the beaks; lunule long and slender; inner margin entire. Of about the same size and shape as the West Coast *P. tantilla*, Gld.; this species can be at once distinguished by its minute cross sculpture. *P. tantilla* is marked only by a few concentric lines.

CARYATIS, Rœm.

C. LORDLYI, n. s.

Shell trigonal, gibbous; beaks anterior; anterior end narrowly produced, most prominent a little above the middle; posterior end prominent, base regularly rounded. Surface marked by fine concentric striæ, most distinct on the anterior end; lunule broad, bounded by a fine, elevated, thread-like line. Internal margin entire.

Length, one inch.

Nearest to *C. albida*, but differs in being more cuneate posteriorly and in the sculpture. Named after Dr. C. R. Lordly, formerly of Limon, now of Cartago, Costa Rica, who materially aided me in making this collection.

C. GUPPYANA, Gabb, n. s., Pl. 47, fig. 73.

Shell moderate in size, thin, convex, short, and almost subtriangular when young, growing more oval as it increases in size. Beaks prominent; anterior end broadly rounded, curving with an unbroken curve across the lunule to the beaks. Posterior end broad and round; base regularly convex. Surface polished and ornamented by numerous small, regular, concentric ribs. Lunule large, and bordered by a sharply impressed line.

Figure. Natural size; drawn from the largest specimen, which is unfortunately broken. Four others of smaller size confirm the above diagnosis.

From *C. Lordlyi* this shell can be distinguished by being slightly less convex; by the anterior end of this being nearly semicircular, the curve only ending at the beaks; while in *Lordlyi*, from the most prominent part of the anterior end, over the lunular region, the outline is nearly a straight line. In *Lordlyi* the posterior end, though rounded, is very narrow, here it is unusually broad. Again, at all ages this shell is regularly costate, while in the other, the ribs are smaller, more irregular, and seem rather like somewhat confused lines of growth; and finally, in this the lunule is bounded by an incised line, while in that it is strongly bordered by a thread-like rib.

From *Cytherea planivieta*, Guppy, with which it is congeneric, the differences are only those of outline. In that, the lunular region is very slightly concave, but the great difference is in the posterior end. That species is cuneiform posteriorly, while this is broadly rounded. There is a very slight difference in the teeth, but only of specific value. The anterior tooth is placed in a slightly different position, and the cardinals vary a little in the distance they are placed apart.

CARDIUM, Linn.

C. PETITIANUM, d'Orb., La Sagra, p. 309, Pl. 27, figs. 50-52.

Fossil, Costa Rica. Living on the Cuban coast.

C. (TRACHYCARDIUM) MURICATUM, Linn., Syst. Nat., 1123.

Very common. Living in the West Indies.

C. (LÆVICARDIUM) SERRATUM, L., Syst. Nat., 1123.

Not common. Living in the West Indies.

C. (FRAGUM) MEDIUM, L., Syst. Nat., 1132.

Half a dozen specimens. Living in the West Indies.

C. (TRACHYCARDIUM) DECLIVE, n. s., Pl. 47, fig. 76.

Shell elongated, subequilateral, convex; beaks prominent, nearly central; surface ornamented by from thirty to thirty-five ribs with narrow interspaces. The top of these ribs are flat and smooth, or marked only by lines of growth, which become more distinct in the interspaces, giving the sides of the ribs a finely serrated appearance. On the posterior side there are a few minute bead-like tubercles between the ribs. The margin slopes almost equally on both sides from the beak to the middle of the shell, the anterior side being but faintly more convex. The crenulations caused by the ribs on the inner margin are obsolete above, and do not become marked except at the base.

Length 1.5 inch; width 1.25 inch.

This species is of the style of *C. subelongatum*, Sby., but the ribs are not so prominent and the upper edges of the valves are not so serrate, and are more regularly sloping from the hinge on both sides than in any other species.

C. (FRAGUM) CALLOPLEURUM, n. s., Pl. 47, fig. 77.

Shell suboval, oblique, convex; beaks placed in advance of the median line; posterior side produced above, convexly truncated; posterior basal portion produced, rounded; surface marked by eighteen to twenty prominent ribs, about six of which, on the middle of the shell, are the largest. These ribs are subacute on top, with sloping sides, and each bears a series of closely placed, bead-like tubercles on its upper edge; the interstices between the ribs are crossed by strong irregular lines. Inner surface marked by deep grooves corresponding to the external ribs.

Length 0.9 inch; width 0.75 inch.

C. Haitense, Sby., a common fossil of Santo Domingo, and recently reported as living in the West Indies,* is the nearest allied species. The differences are: That shell has from twenty to twenty-four ribs; while the maximum number of this is twenty. In that the ribs are square on top; in this they are subacute; the tubercles in *Haitense* are much larger than in the present species; the internal surface of the *callopleurum* is deeply grooved, while in *Haitense* no traces of the external ribs extend beyond the pallial line; and finally, while *C. Haitense* varies considerably in the strength of the umbonal angle, some specimens falling off from a prominent rib at a right angle, while others are quite rounded; in the present species there is no trace of such an angle, the surface curving over gently from the posterior area to the top of the shell.

PAPYRIDEA, Sw.

P. BULLATA, L. (Sp.), Enc. Meth., Pl. 296, f. 6.

Abundant. Living in the West Indies.

CHAMA, Linn.

C. MACROPHYLLA, Chemn. Conch., v. 7, Pl. 52, figs. 514, 515.

Common. Living in the West Indies.

* Guppy, Ann. Mag. N. Hist., 4 ser., v. 15, p. 51.

MYSIA, Leach.

M. ORBELLA, Gld. sp.

Lucina (Diplodonta) orbella, Gld. Otia, p. 212.

Described from San Diego. I cannot find a single point of difference between my fossils and authentic specimens of Dr. Gould's species in the Museum of the Academy of Natural Sciences of Philadelphia.

ASTARTE, Sby.

A. MERIDIONALIS, Gabb, n. s., Pl. 47, fig. 78.

Shell minute, robust, triangular, oblique; beaks placed well in advance and prominent; posterior cardinal margin sloping rapidly downwards and backwards, nearly straight, curving into the posterior end, which is narrow, truncated, and slopes outwards a very little. Anterior end sloping much more abruptly than the posterior, and slightly concave. The most prominent part of the anterior end is near the base. Base in front of the sharp posterior angle very slightly concave, and bending downwards becoming broadly convex in the middle and in front. Surface marked by a few large concentric ribs becoming smaller on the upper part of the shell.

Length 3 mm.

Very rare near Limon, Costa Rica.

GOULDIA, C. B. Ad.

G. GUADALUPENSIS, d'Orb. sp.

Crassatella Guadalupensis, d'Orb., La Sagra, p. 289, Pl. 27, f. 24-26.

Mr. Guppy is certainly wrong (Quart. Journ. Geol. Soc., 1876, p. 530) in including this with *Martinicensis*. The error is so great that I may be almost permitted to think that he has not seen the present species. I infer so from the fact that I did not find *it*, but the other species only, fossil in Santo Domingo, and now I find this alone, and very abundant in Costa Rica. *G. Martinicensis* is a regular equilateral shell, while among over sixty specimens now before me of the present species, not one is perfectly equilateral and some are very oblique, not only in the adult, but even in the very young stage.

As to the change of generic name from *Gouldia* to *Crassinella*, I believe all leading authorities have declared against the principle. To go through natural history names and give new ones wherever a name is repeated would create a terrible revolution in nomenclature, and could accomplish no good whatever. No confusion exists. Nobody could mistake *Gouldia* the shell for *Gouldia* the bird, and what cannot be done on a grand scale certainly cannot be done in individual cases.

To form a faint idea of the number of cases in which generic names are repeated in various orders, let the reader refer to the general index of Agassiz's *Nomenclator Zoologicus*; and then remember that that only tells us the state of things thirty years ago, when names were probably not half so numerous as they are now.

CARDITA, Brug.

C. CONRADIANA, Gabb, n. s., Pl. 47, fig. 79.

Shell minute, oblique; beaks very prominent and pointed strongly in advance; posterior cardinal line sloping rapidly; posterior end abruptly truncated; anterior end and base rounded; anterior end somewhat excavated under the beaks, the lunule large and prominent. Surface marked by about eighteen large, curved, beaded ribs.

Length $1\frac{1}{2}$ mm.

LITHOPHAGA, Bolt.

L. INCURVA, n. s., Pl. 47, fig. 80.

Shell small, very convex, thicker than wide, arcuated; beaks anterior, very prominent, and distinctly incurved; anterior end produced below, basal margin concave; surface marked only by heavy, irregular lines of growth.

Length 0.9 inch; width 0.35 inch; diameter measured through the greatest convexity of the two valves 0.5 inch.

But a single specimen was found but which, fortunately, gave both valves separated in a beautifully perfect condition.

CRENELLA, Brown.

Sub-gen. MODIOLARIA, Beck.

C. (M.) TRANSLUCIDA, Gabb, n. s., Pl. 47, fig. 81.

Shell minute, very thin, translucent; elongated; beaks large and overhanging the anterior end; posterior cardinal margin nearly horizontal; posterior end broadly rounded and sloping outward; anterior end not prominent; base divided into three parts, each of which has a broadly convex outline. The posterior third of the shell is marked by numerous fine, radiating, and slightly curved ribs. The middle is smooth, and the anterior end is marked by similar ribs.

Length of largest specimen is 4 mm.

This shell is very similar to *C. (M.) discors*, Linn., in form and ornament, but the ribs are finer and more numerous, and the shell is altogether more oblique, more produced in the posterior basal region.

PINNA, Linn.

P. RUDIS? Linn., Enc. Meth., Pl. 199, fig. 3.

A single imperfect valve, too poor for a positive identification.

ARCA, Linn.

A. IMBRICATA, Brug., Enc. Meth., p. 98.

Common. Although this shell was said to come from the South Sea, our fossil is identical with recent specimens of the West Indies, which seem without doubt to be Bruguiere's species.

A. (ANDARA) DESHAYSI, Hanley, Sp. of Shells, p. 155.

A well known West Indian species.

A. (A.) CONSOBRINA, Sby., Quart. Journ. Geol. Soc., London, v. 6, p. 52, Pl. 10, fig. 12.

Described from the Santo Domingo Miocene by Sowerby, and since found in the same formation in Jamaica.

A. (A.) GRANDIS, Brod. and Sby., Zool. Jour., v. 4, p. 365.

A. patricia, Sby., Q. J. G. Soc., v. 6, p. 52.

A. Chiriquensis, Gabb, Proc. Phila. Acad., 1860, p. 567.

But a single young shell was found, but it is identical with specimens of the corresponding age found by me in the Santo Domingo beds. Sowerby's attempt to divide the fossil from the living form is not sustained by my examination of a large series of the fossils, and on comparing the originals of my species, I find that I have been misled by the persistence of granules on the ribs in even large shells, a character which is usually not retained after the individuals acquire a diameter of more than an inch. Their presence in large shells among the Chiriqui fossils is probably the result of their having lived in very quiet water, as is indicated by the extremely fine grained clay in which they are imbedded.

AXINÆA, Poli.

A. SERICATA, Rve. (sp.), P. Zool. Soc., 1843, Icon., Pl. 9, fig. 43.

Very abundant fossil; living in the West Indies.

NUCULA, Lam.

N. LIMONENSIS, Gabb, n. s., Pl. 47, fig. 82.

Shell small, oblique, beaks very far in advance, posterior end cuneate; anterior end and base rounded. Hinge robust, central fosset very sunken, small and oblique. Outer surface smooth and polished. One specimen before me shows rather

heavy lines of growth, and another has them developed into pretty regular concentric ribs.

Length, 3 mm.

A small, inconspicuous shell, of orthodox shape and appearance, and about which, consequently, little can be said.

N. MOENENSIS, Gabb, n. s., Pl. 47, fig. 83.

Shell minute, *Telliniform*, nearly equilateral, the beaks central, the posterior cardinal margin slightly arched, the anterior a very little concave, and both sloping at about the same angle. Anterior end produced, obliquely truncated, and causing, by its form, the resemblance to *Tellina*; base and posterior end regularly rounded. Surface smooth and unornamented.

Length, $3\frac{1}{2}$ mm.

This is a remarkable case of imitation of form; and perhaps nobody could conjecture the true genus, without the actual proof. This, fortunately, I have. The hinge is slender, long, and the regular *Nucula* teeth, though small, are well marked and numerous.

PECTEN, Linn.

P. EXASPERATUS, Sby., Thes. Conch., p. 54, Pl. 18, figs. 183-186.

Rare. Living, Mediterranean.

JANIRA, Schum.

J. MEDIA, Lam. (sp.), A. S. Vert., v. 7, p. 130.

Common. Living, West Indies.

J. LÆVIGATA, n. s., Pl. 47, fig. 84.

Shell thin, sub-orbicular, broad; lower valve convex, equilateral; surface polished and marked by about twenty scarcely perceptible broad ribs, represented internally by an equal number of pairs of thin threadlike ribs ending a little short of the margin of the shell; ears nearly equal; the right ear marked by three or four fine radiating, linear ribs. Upper valve slightly concave, the ribs being indicated externally by faint impressed lines, crossed by regular, fine lines of growth; internally this valve has the same character of ribs as the other.

Length and width, each 1.3 inches.

SPONDYLUS, Linn.

S. AMERICANUS, Lam., A. S. V., v. 7, p. 185.

Common.

OSTREA, Linn.

O. VIRGINICA, Gmel., p. 3336.

Common.

O. BOREALIS, ? Lam., A. S. V., vol. 7, p. 220.

There is a small plicate oyster in the deposit which I cannot separate from the well-known northern form. It is certainly not the same as the Santo Domingo fossil *O. Haytensis*.

ANOMIA, Linn.

A. EPHIPPIUM, Linn., Enc. Meth., Pl. 170, figs. 6, 7.

Not very common.

The Terrestrial Mollusca Inhabiting the Cook's or Harvey Islands.

By ANDREW GARRETT.

THE Cook's or Harvey Islands are embraced in an area between 157° and 160° W. Long., and between 18° 40' and 22° 20' S. Lat. Their distance from the nearest point of the Society Islands is about 480 miles to the southward and westward, and 640 miles southeast of Samoa.

They comprise seven islands, mostly of small size, three of which are still virgin grounds to the shell collector. Rarotonga, Atiu, Aitutaki, and Mangaia, from whence all the known species have been derived, are, excepting the former, only partially explored. Rarotonga, which is the largest and most lofty island, has yielded a far greater percentage of species, simply because it has been much more thoroughly explored than the others.

The earliest known species were collected by Dr. Dean, during a cruise through the group in 1861, when he discovered *Helix fratercula* and *Omphalotropis ovata*, and obtained many examples of *Partula hyalina* on Mangaia. In 1865 I visited Aitutaki, Atiu, Mangaia, and Rarotonga, and found many new species, all of which were forwarded to the late Mr. Pease for description. In 1869 I again visited Rarotonga, and devoted six months to the investigation of its natural history, and discovered a number of new species, which have been described and figured in the Proceedings of the Academy of Natural Sciences of Philadelphia.

GENUS MICROCYSTIS, Beck.

M. EXCRESCENS, Mousson.

Nanina excrecens (*Microcystis*), Mousson, Journ. de Conch., 1870, p. 115, Pl. 7, fig. 5; 1871, p.

8. Paetel, Cat. Conch., p. 84.

Nanina excrecens, Schmeltz, Cat. Mus. Godeff., v. p. 91.

Helix excrecens, Pfeiffer, Mon. Hel., vii. p. 67.

Nanina subexcrecens, Garr. MS.

I gathered nearly one hundred examples of this small species at Rarotonga, where they occurred under damp, rotten wood and beneath moist, decaying leaves on the side of inland ravines.

Prof. Mousson's type specimens were found by Dr. Graffe in the Viti Islands, and he subsequently discovered it in the Tonga Group.

It belongs to a small group of Polynesian species, which are characterized by a nodulous or dentate columella.

The only variation consists of a more or less depressed spire.

M. SUBCICERULA, Mousson.

Nanina subcicercula, ("Mouss."), Schmeltz, Cat. Mus. Godeff., v. p. 91.

Nanina subcircula, Binney, Proc. Phil. Acad. Nat. Sci., 1875, p. 248, Pl. 20, fig. 1 (Dentition).

Helix subcicercula, Pfeiffer, Mon. Hel., vii. p. 482.

This common species was found associated with the preceding, and so far as known is peculiar to Rarotonga Island.

As the late Dr. Pfeiffer merely quotes the name, I suppose there has not been any description published; I subjoin the following:—

Shell imperforate, depressed, thin, fragile, smooth, very brilliant, pellucid, luteous-horny, with or without a few irregular whitish dots; spire short, convexly-conical, obtuse; suture linear; whorls five, convex, faintly striate, regularly and moderately increasing, last one not descending in front, angulate at the periphery; base convex, indented at the axis; aperture slightly oblique, lunate, with a faint angle corresponding to the one on the periphery; peristome thin, simple with remote margins; columella thickened with white callus.

Major diameter 9, height 5 mill.

Mr. Binney gives a wrong locality.

M. VENOSA, Pease.

Helix venosa, Pease, Amer. Journ. Conch., 1866, p. 290, Pl. 21, fig. 2. Pfeiffer, Mon. Hel. vii., p. 71.

Helicopsis venosa, Pease, Proc. Zool. Soc., 1871, p. 475.

Nanina radians, Schmeltz (not of Pfeiffer), Cat. Mus. Godeff., v. p. 91.

Extremely abundant on the foliage of bushes, and is widely diffused throughout the inland ravines on Rarotonga.

The animal is pale cinerous, with lead-colored tentacles, and the lobes of the mantle are freckled with light brown. The foot is elongate, narrow, and in length equals the larger diameter of the shells. The mucous gland is papilliform. This and the preceding species are viviparous.

Mr. Pease's short description is not very satisfactory; but his figure is sufficiently accurate to identify the species. Having examined hundreds of examples I have failed to discover the "*blackish*" lines mentioned by the above author.

The upper portion of the shell is marked with more or less crowded, exceedingly fine radiating and concentric or spiral cinereous lines. The basal portion, which is more shining than above, has the lines more distinctly defined. The

lines on the upper parts are frequently so crowded as to give that portion an uniform cinereous color. The largest examples measure $9\frac{1}{3}$ mill. in diameter.

Examples sent to the Godeffroy Museum were referred to *radians*, Pfr. After a careful comparison with Pfeiffer's description and Reeve's figure, as copied in Dr. Cox's Australian Land Shells, I do not hesitate to consider *venosa* as distinct from *radians*.

M. DISCORDICE, Garrett.

Shell small, minutely perforate, depressly globose, smooth, fragile, thin, pellucid, very brilliant, lightly striate, pale corneous; spire depressly conoid, convex; apex obtuse; suture slightly impressed; whorls $4\frac{1}{2}$ –5, convex, slowly and regularly increasing, the last angulated on the periphery, not deflected in front, convex beneath; perforation punctiform; aperture subvertical, angulate lunate; peristome thin, straight, margins remote; columella slightly expanded.

Height $2\frac{1}{2}$, major diameter 4 mill.

The animal is pale cinereous, with dusky head and tentacles. Foot oblong, rather narrow, compressed, in length equal to the major diameter of the shell.

A very fragile species found in great abundance beneath rotten wood and among decaying leaves. It is diffused throughout the group, and ranges in all parts of the Society Islands. I took a few examples at the Marquesas, which differed none from Cook's Island and Tahitian specimens.

According to Pfeiffer's description of *subtilis*, with which this has hitherto been confounded, this certainly cannot be that species. Our shell is one-third smaller, angulate, and the whorls are not margined with a red line.

Pfeiffer's description of *subtilis* is as follows:—

“*T. imperforata, depressa, tenerrima, nitida, pallide cornea; spira vix exserta; confr. 4\frac{1}{2}–5 planiusculi, sensim accrescentes, ultimus basi paulo convexior; sutura interdum rufo-marginata; apertura transverse lunaris; perist. simplex, acutum. Diam. maj. 6, min. $5\frac{1}{3}$, alt. $3\frac{1}{3}$ mill.” (Pfeiffer.)*

M. CONULA, Pease.

Helix conula, Pease, Proc. Zool. Soc., 1861, p. 243. Pfeiffer, Mon. Hel., v. p. 62; vii. p. 75.

Helicopsis conula, Pease, Proc. Zool. Soc., 1871, p. 475.

Nanina Tongana, “Mousson” (not of Quoy), Schmeltz, Cat. Mus. Godeff., v. p. 91.

Nearly two hundred examples of this species were taken from the foliage of a large shrub, near the sea-shore at Rarotonga. Though carefully searched for, I failed to detect it in any other part of the island. Rarotonga specimens, with the exception of being a little larger, differed none from Society Island shells. Mr.

Pease, who described examples from the latter group, does not mention the color, which varies from whitish-corneous to luteous or dark brownish-horn color.

It belongs to a peculiar group, which Prof. Mousson has named *Trochonanina*. They differ from the typical *Microcystis* in being acutely angulate, and conical or trochiform in shape. Like the latter, they have the columella either simple or toothed.

The animal is pale yellowish-white. The foot elongate, compressed, grooved on the sides, and in length equals one and a half times the larger diameter of the shell. The eye-tentacles are long and slender; the labials small. The mucous gland is prominent.

The mucus of this, and all the other species of *Trochonanina* with which I am acquainted, is unusually tenacious, and the animals possess the habit of "thread-spinning" to perfection; so much so that it requires no small amount of patience while gathering specimens to detach them from the fingers, and secure them in the collecting box or vial.

They are all viviparous.

M. SAMOENSIS, Mousson.

Nanina Samoensis, Mouss., Jour. de Conch., 1865, p. 165.

Helix Samoensis, Pfeiffer, Mon. Hel., v. p. 70; vii. p. 82.

Zonites (Conulus) Samoensis, Mouss., Jour. de Conch., 1869, p. 331; 1870, p. 116; 1871, p. 10.

Helicopsis Samoensis, Pease, Proc. Zool. Soc., 1871, p. 475.

Zonites Samoensis, Schmeltz, Cat. Mus. Godeff., v. p. 90; Paetel, Cat. Conch., p. 86.

This small species is very abundant beneath dead wood and under loose stones in the low-land forests near the sea-shore. It only occurred to my notice at Rarotonga and Nukuhiva (Marquesas) in Southeastern Polynesia. In Southwestern Polynesia it is generally diffused throughout Samoa, Tonga, and the Viti Islands. Dr. Graffe discovered it in the low coral islands of the Ellice Group. It never occurs in the inland forests.

It will be observed by the above references that this little shell, which was described, first as a *Nanina*, was subsequently removed by the author to the genus or subgenus *Conulus*. It appears to me to be more nearly related to *Microcystis* than the latter genus, and connects the former with *Trochonanina*.

GENUS PATULA, Held.

Contrary to the views of the late Mr. Pease, I follow Prof. Mousson in referring the following species to the above genus. The former author classed them with *Pitys*, and by other writers they have been referred to *Endodonta*.

They differ from the former genus in the total absence of laminæ in the palate, and, with very few exceptions, they are wanting on the parietal region. The whorls of all those species *without* parietal lamina increase in size more rapidly, and the body whorl is broader, and the aperture less contracted than in *Pitys*.

Patula jugosa and *tenuicostata* have a very close resemblance to the United States *Patula striatella*.

The rare occurrence of two or three species with parietal lamina connects the genus with *Pitys*, and is one of the numerous instances of the difficulty experienced in the attempt to separate the *Helices* into sharply-defined genera or sub-genera.

The Polynesian *Patulæ*, which culminate in the southeastern groups, are generally diffused throughout the various islands in Polynesia. They have not, as yet, been discovered in Micronesia; but, owing to their small size, dark color, and habits of concealment, have probably escaped the notice of collectors. South of the equator they range west as far as the Viti Islands, and, in all probability, are diffused throughout Melanisia. A number of species are recorded from South Australia and Tasmania.

They are all strictly terrestrial, and are found lurking under rotten wood, decaying leaves, and adhering to the under side of loose stones.

P. TENUICOSTATA, Garrett.

Pitys tenuicostata, Garr., Amer. Journ. Conch., 1872, p. 229, Pl. 12, fig. 23.

Patula tenuicostata, Schmeltz, Cat. Mus. Godeff., v. p. 94.

Helix tenuicostata, Pfeiffer, Mon. Hel., viii. p. 547.

This interesting shell cannot easily be confounded with any other South Polynesian species. As compared with the Sandwich Island *jugosa*, which it more nearly resembles than any other, it is not so large, the umbilicus smaller, the spire more planulate, and the last whorl is broader.

So far as known, it is peculiar to Rarotonga, and, though rather widely diffused over the island, is comparatively rare.

It may readily be distinguished by its uniform pale brownish horn color, and the thin rather distant radiating riblets.

P. CANALIS, Garrett.

Pitys canalis, Garr., Amer. Journ. Conch., 1862, p. 227, Pl. 19, fig. 17

Patula canalis, Schmeltz, Cat. Mus. Godeff., v. p. 93.

Helix canalis, Pfeiffer, Mon. Hel., vii. p. 546.

This well-marked species is also confined to Rarotonga, where we obtained a few examples in one valley only.

It can easily be distinguished by its large size, perfectly flat spire, large open umbilicus, fine crowded rib-like striæ, and profound suture.

P. ATIENSIS, Pease.

Pithys Atiensis, Pease, Jour. de Conch., 1870, p. 394.

Pityis Atiensis, Pease, Proc. Zool. Soc., 1871, p. 453, 474.

Patula vicaria, Mousson, Jour. de Conch., 1871, p. 11, Pl. 3, fig. 2; 1873, p. 104. Schmeltz, Cat. Mus. Godeff., v. p. 93.

Helix vicaria (*Patula*), Paetel, Cat. Conch., p. 96.

Patula modicella, Schmeltz (Ferussac?), Cat. Mus. Godeff., v. p. 93.

Helix Atiensis, Pfeiffer, Mon. Hel., vii. p. 165.

Helix vicaria, Pfeiffer, Mon. Hel., vii. p. 187.

I obtained Pease's type specimens in a forest near the sea-shore at Atiu, where it was abundant. It also occurred, but more sparingly, at Aitutaki, and subsequently I took hundreds of examples in different parts of Rarotonga.

Specimens from the latter location attain a larger size than mentioned by Pease, and vary slightly in the size of the umbilicus, and some have the spire more elevated than others.

The color is also somewhat variable.

After a careful comparison with Mousson's *vicaria*, I fail to note a single distinguishing character to separate the two shells. The shape, coloration, sculpture, and variation are precisely the same, and, except in color, can scarcely be separated from the Tahitian *modicella*.

Mousson's *vicaria*, collected by Dr. Graffe, is widely diffused through Tonga and the Ellice group of islands.

Undetermined examples of *Atiensis*, sent to the Museum Godeffroy, were referred, part to *vicaria* and part to *modicella*.

P. PROXIMA, Garrett.

Pityis proxima, Garr., Amer. Jour. Conch., 1872, p. 230, Pl. 19, fig. 24.

Patula proxima, Schmeltz, Cat. Mus. Godeff., v. p. 93.

Helix proxima, Pfeiffer, Mon. Hel., vii. p. 543.

Not uncommon in several valleys on Rarotonga. It is most nearly allied to the preceding species, but may be distinguished by its much smaller umbilicus, deeper suture, and more particularly by the peculiar angular emargination on the upper portion of the peristome. A few examples were found of an uniform deep black color.

P. RUDIS, Garrett.

Pity's rudis, Garr., Amer. Jour. Conch., 1872, p. 227, Pl. 19, fig. 18.

Patula rudis, Schmeltz, Cat. Mus. Godeff., v. p. 93.

? *Patula sublamina* ("Mouss."), Schmeltz, Cat. Mus. Godeff., v. p. 94.

Helix rudis, Pfeiffer, Mon. Hel., vii. p. 547.

A very abundant species, peculiar to Rarotonga, where we gathered hundreds in several valleys.

I know of no species with which it is likely to be confounded. It can easily be recognized by its rude, irregular, sharp, rib-like striæ, which are more or less deciduous, dark-brown color, small umbilicus, and the slight concave depression on the declivous body whorl.

P. DECORTICATA, Garrett.

Pity's decorticata, Garr., Amer. Jour. Conch., 1872, p. 228, Pl. 19, fig. 19.

Pity's Otareæ, Garr., Amer. Jour. Conch., 1872, p. 288, Pl. 19, fig. 21.

Patula decorticata, Schmeltz, Cat. Mus. Godeff., v. p. 93.

Patula Otareæ, Schmeltz, Cat. Mus. Godeff., v. p. 94.

Helix decorticata, Pfeiffer, Mon. Hel., vii. p. 592.

Helix Otareæ, Pfeiffer, Mon. Hel., vii. p. 543.

This, which is the most abundant species found on Rarotonga, is, so far as I could ascertain, confined to two valleys, which are about three miles apart; one occupied by the type, and the other by the variety *Otareæ*.

As compared to *canalis* it is smaller, the umbilicus less open, the ribs larger, rougher, and more distant. The sutural line is also less profound and the color different.

After a careful study of numerous examples of *decorticata* and *Otareæ*, I have decided the two to be specifically the same, though the latter may be retained as a permanent variety, characterized by its uniform deep brown-black color. The former is a little larger, usually decorticated, and much lighter colored; but in shape, size of umbilicus, and sculpture differs none from *Otareæ*.

P. HARVEYENSIS, Garrett.

Pity's Harveyensis, Garr., Amer. Jour. Conch., 1872, p. 228, Pl. 19, fig. 20.

Patula Harveyensis, Schmeltz, Cat. Mus. Godeff., v. p. 93.

Helix Harveyensis, Pfeiffer, Mon. Hel., vii. p. 542.

Not uncommon, and peculiar to Rarotonga. It attains a little larger size than the preceding, and may be distinguished from that species by its smaller and more crowded riblets and different color. In shape and markings it is very closely allied to *Patula complementaria*, a Samoa species, but quite different in the style of sculpture.

P. YOUNGI, Garrett.

Pity's Youngi, Garr., Amer. Jour. Conch., 1872, p. 229, Pl. 19, fig. 22.

Patula Youngi, Schmeltz, Cat. Mus. Godeff., v. p. 93.

Helix Youngi, Pfeiffer, Mon. Hel., vii. p. 543.

This species, which is also peculiar to Rarotonga, is somewhat rare, and only occurred to my notice in one valley, the habitat of the typical *decorticata*.

It differs from *canalis* in the total absence of spots and stripes, lighter color, more elevated spire, broader and flatter whorls, and smaller umbilicus. The description (l. c.) should read 4, not $4\frac{1}{2}$, whorls, which is one less than in *canalis*.

P. PLANOSPIRA, Garrett.

Shell small, broadly umbilicated, discoidal, thin, with slightly oblique, rib-like, crowded striæ; horn color rayed and tessellated with brown; spire planulate; suture deeply impressed; whorls six, convex, slowly and regularly increasing, last one rounded, not deflected in front, flatly convex beneath; umbilicus large, perspective, one-third the major diameter of the shell; aperture oblique, rather narrowly lunate; peristome thin, simple.

Major diameter 3, height $1\frac{1}{2}$ mill. (Mus. Godeffroy).

Hab. Rarotonga Island.

A very rare species characterized by its peculiar flat spire, depressed base, numerous narrow whorls, and broad umbilicus. As viewed from above it closely resembles the next species in its narrow whorls, but is smaller, the ribs finer, and the planulate spire will at once separate them.

P. UNILAMELLATA, Garrett.

Pity's unilamellata, Garr., Proc. Phil. Acad. Nat. Sci., 1873, p. 235, Pl. 3, fig. 67.

This is also a very rare species, peculiar to Rarotonga. The single revolving lamina on the parietal region will readily determine it from any of the preceding species, and is one of those species which by the development of a parietal lamina connects *Patula* with the following genus.

GENUS PITYS, Beck.

I restrict this genus to a group of small *Helices*, the type of which is *Helix Oparica*, Anton. So far as known, they are peculiar to the South Sea islands, and have their metropolis in Southeastern Polynesia, where they are the most numerous, both in species and individuals. They have spread north to the Sandwich Islands, and west to the Viti Group.

They may be distinguished by their depressed orbicular form, narrow whorls,

costulate striæ, rounded (rarely subangulate) body whorl, and by the numerous internal laminæ both in the palate and on the parietal region. The umbilicus is very rarely closed, and, with few exceptions, is smaller, and the walls are more precipitate than in *Patula*. The aperture is also more contracted and more vertical.

Prof. Mousson unites them with *Endodonta*, a distinct genus confined to the Sandwich and Society Islands. Pætel and Schmeltz have affiliated them with *Patula*, the former, however, recognizing *Endodonta* as a distinct subgenus, but makes it less natural by having included the remarkable group of which *Helix bursatella*, Gould, is the type, and which Mr. Pease referred with a doubt to *Pityis*.

P. ZEBRINA, Garrett.

Pityis zebrina, Garr., Proc. Phil. Acad. Nat. Sci., 1873, p. 234, Pl. 3, fig. 66.

Of this rare species I obtained only half a dozen specimens, which were found in the same valley with *Patula decorticata*, var. *Otareæ*. Its most obvious characters are the conspicuous stripes and spots on a pale ground, and the distant thin membranous riblets which in adults are more or less lacerated. The parietal region is furnished with two and the palate with three or four laminæ.

P. MULTILAMELLATA, Garrett.

Pityis multilamellata, Garr., Amer. Jour. Conch., 1872, p. 230, Pl. 19, fig. 25.

Patula multilamellata, Schmeltz, Cat. Mus. Godeff., v. p. 94.

Helix multilamellata, Pfeiffer, Mon. Hel., vii. p. 519.

Not uncommon, and obtained in two separate valleys on Rarotonga. It is quite distinct from any other South Polynesian species. The numerous narrow whorls ($6\frac{1}{2}$ to 7), deep sutures, vertical umbilicus, thin crowded riblets, and numerous (11) internal laminæ will readily distinguish it.

P. IMPERFORATA, Pease.

Pithys imperforata, Pease, Jour. de Conch., 1870, p. 394.

Pityis imperforata, Pease, Proc. Zool. Soc., 1871, p. 453, 474.

Patula Aitutakiana ("Mouss."), Schmeltz, Cat. Mus. Godeff., v. p. 94.

Helix imperforata, Pfeiffer, Mon. Hel., vii. p. 256.

A very abundant species, peculiar to the island of Aitutaki. It may be easily distinguished by its imperforate base, small, very thin crowded costulate striæ, and numerous internal laminæ, of which there is one or two on the parietal wall, and very frequently with several elevated striæ which run parallel with the laminæ. On the base and palate the laminæ range from three to five. The young shells are also imperforate.

Mr. Pease's first description, which is copied by Dr. Pfeiffer, is not so accurate as the second one published in the "Proceedings of the Zoological Society." It is remarkable that the former author should have compared this species with Jacquinot's *rotula*, which is described as a smooth, horn-colored shell, which Dr. Pfeiffer refers to the section or subgenus *Microcystis*. Judging from Anton's description of *Oparica*, though quite distinct, it is the nearest allied species.

P. ROTELLINA, Pease.

Pithys rotellina, Pease, Jour. de Conch., 1870, p. 393.

Pithys rotellina, Pease, Proc. Zool. Soc., 1871, p. 453, 474.

Helix rotellina, Pfeiffer, Mon. Hel., vii. p. 262.

Like the preceding species, this is also peculiar to Aitutaki, and is nearly equally as abundant, both of which occur in forests near the sea-shore. It is the smallest known Polynesian species, and could easily be mistaken for the young of *imperfurata*. It is, however, only half the size of that species, and the umbilicus though small is pervious, and the striæ are so firm and crowded as to impart a velvety appearance to the surface of the shell.

Of Mr. Pease's two descriptions, the one in the "Proceedings of the Zoological Society" is the most correct, though Dr. Pfeiffer, as in the preceding species, has copied the first. I cannot understand how Mr. Pease could have overlooked the laminæ in the palate, of which there are three or four, and most generally raised striæ on the wall of the aperture.

P. RAROTONGENSIS, Pease.

Pithys Raratongensis, Pease, Jour. de Conch., 1870, p. 395.

Pithys Raratongensis, Pease, Proc. Zool. Soc., 1871, p. 453, 474.

Helix Raratongensis, Pfeiffer, Mon. Hel., vii. p. 257.

I collected Mr. Pease's type specimens at Atiu, *not* Rarotonga as stated by the above author.

As in the two preceding species, Pease's first diagnosis, which is reproduced by Dr. Pfeiffer, is not very satisfactory. The second one (l. c.) is very correct as regards shape, sculpture, and number of internal laminæ.

The nearest allied species is *P. De Gagei*, inhabiting one of the Austral Islands; but that species has twice the number of laminæ.

GENUS LIBERA, n. g.

Shell small, widely umbilicated, umbilicus (in adults) strongly constricted so as to form a cavernous or pouch-like cavity; whorls 7-9, costulate or striate, last one angulate or carinate, rarely rounded; aperture subrhomboidal or securiform;

peristome thin, simple, straight; parietal region with one or two, and the palate with (rarely without) two or three internal laminæ; columella emarginate and furnished with a spiral fold.

Animal small; eye peduncles long and slender; tentacles small; foot short, narrow, pointed behind.

"Teeth (*L. tumuloides*) 17-1-17, with about seven perfect laterals. The base of attachment of the centrals is subequilateral. There are distinct side cutting points and cusps. The median cusp is long. Laterals unsymmetrical as usual. Transition formed as usual. Marginals low, wide, with one long, large, bifid inner cutting point and one small side cutting point." (Binney.)

Remarkable for their singular habit of ovopositing into their cavernous umbilicus. The eggs usually from four to six, or the same number of very young shells may frequently be seen closely packed in the cavity. The latter are shaped almost exactly like a half-grown *Planorbis trivolis*. The first whorl is smooth, the second one with radiating costulate striæ, and the internal laminæ both on the penultimate and second whorl can be distinctly seen through the transparent shell.

The peculiar constriction of the umbilicus does not occur until the last two whorls are completed, previous to which it is very open or cup-shaped.

Certain species more completely secure the safety of the eggs by the formation of a very thin shelly plate which projects from the columellar and parietal region, and nearly closes the umbilical opening. It is subsequently either broken away or absorbed by the animal to facilitate the escape of the young shells.

All the species, which are gregarious, live under loose stones, rotten wood, and less frequently buried in decaying leaves. They range from the low lands near the sea-shore to upward of two thousand or more feet above sea-level.

So far as known, the genus, which comprises about a dozen species, is peculiar to the Society and Cook's Islands. In the former group they are confined to Tahiti and Moorea. Dr. Pfeiffer mentions the Marquesas as the habitat of *Jacquinoti*, which is undoubtedly an error. I searched every island, except one, in that group and did not find a single specimen. Mr. Pease, who received large numbers of small land shells from that group, also failed to get specimens, and shared my doubts in regard to its occurrence there.

The latter author classed them with *Pityls*. Albers and Pætel referred them to *Endodonta*, and Schmeltz to *Patula*. They are more nearly related to *Endodonta* than to either *Pityls* or *Patula*; but the peculiar formation of the umbilicus will readily distinguish them from any of the above genera.

L. FRATERCULA, Pease.

Helix sculptilis, Pease, Proc. Zool. Soc., 1864, p. 669. Pfeiffer, Mon. Hel., v. p. 217.

Helix fratercula, Pease, Amer. Jour. Conch., 1867, p. 104. Pfeiffer, Mon. Hel., vii. p. 253. Paetal, Cat. Conch., p. 94.

Pity's fratercula, Pease, Proc. Zool. Soc., 1871, p. 475.

Patula sculptilis, Schmeltz, Cat. Mus. Godeff., v. p. 94.

Mr. Pease's type specimens were collected by Dr. Dean at Mangaia, and, subsequently, I obtained numerous examples in the same locality, as well as at Rarotonga, Aitutaki, and Atiu. It is probably diffused throughout the group. It is confined to the low lands near the sea-shore, where it occurs in great numbers in forests.

At Rarotonga they attain a larger size than found elsewhere, and the spire is frequently more elevated than mentioned by Mr. Pease. Specimens now before me measure seven millimetres in diameter by five in height. Mangaia examples are uniform luteous horn color, and at Atiu, where they are smaller, they are darker and frequently obscurely variegated with reddish-brown.

It is surprising that Mr. Pease should have overlooked the very conspicuous internal lamelliform teeth in the palate, of which there are *always two*, and more frequently three, between the periphery keel and columella, which latter is also furnished with a spiral fold, though not alluded to by the above author.

The laminæ are constant during the different stages of growth, but in adult shells are only present in the two last whorls, the preceding ones being absorbed by the animal.

Rarotonga examples are cretaceous or horn color, sometimes beautifully variegated with stripes and tessellations of a reddish-brown color. The ribs in passing over the acute prominent keel give it a beautifully corded appearance.

The habitat "Gambier" in Pfeiffer's Mon. Hel., vol. vii., is erroneous.

L. CAVERNULA, Garrett.

Pity's cavernula, Garr., Amer. Jour. Conch., 1872, p. 226, Pl. 19, fig. 16.

Patula cavernula, Schmeltz, Cat. Mus. Godeff., v. p. 94.

Helix cavernula, Pfeiffer, Mon. Hel., vii. p. 568.

Found plentifully in the mountain ravines, and is peculiar to Rarotonga.

It is closely related to the preceding species, but may be distinguished by its darker color, smaller ribs, less prominent keel, and the shallow groove immediately above the revolving keel is not so conspicuous. In a careful comparison of numerous young examples of different ages I remark the umbilicus is considerably broader in *cavernula* than in *fratercula*.

L. TUMULOIDES, Garrett.

Pitys tumuloides, Garr, Amer. Jour. Conch., 1872, p. 225, Pl. 19, fig. 15.

Patula tumuloides, Schmeltz, Cat. Mus., Godeff., v. p. 94.

Helix tumuloides, Pfeiffer, Mon. Hel., vii. p. 567.

Endodonta tumuloides, Binney, Proc. Phil. Acad. Nat. Sci., 1875, p. 248, Pl. 21, fig. 6. (Dentition.)

I took over three hundred examples of this species, all obtained in a small area of about one-half an acre, and nearly two miles inland, at Rarotonga. Though carefully searched for, I failed to discover a single example in any other part of the island.

It is more elevately dome-shaped than the two preceding species, and the whorls are more depressed, and only the first two or three whorls are ribbed. The carination is smaller, smoother, and there is but one lamina on the parietal region.

LIBERA, n. sp.

This is undoubtedly the smallest species of the genus. Only five examples were found in the low-land forests at Aitutaki, and are deposited in the Godeffroy Museum, Hamburg.

GENUS STENOGYRA, Shuttleworth.

S. TUCKERI, Pfeiffer.

Bulimus Tuckeri, Pfeiffer, Proc. Zool. Soc., 1846, p. 30; Mon. Hel., ii. p. 158; iii. p. 400; iv. p. 461; vi. p. 31; viii. p. 138; (*Opeas*) Vers., p. 156. Reeve, Conch., Icon, Pl. 68, sp. 481. (*Opeas*) Cox, Mon. Aus. Land Shells, p. 69, Pl. 13, fig. 9. Brazier, Quar. Journ. Conch., i. p. 272.

Stenogyra Tuckeri, (*Opeas*) Albers, 265. (*Opeas*) Frauenfeld, Verh. Zool. Bot. Wien., xix. p. 873. Pease, Proc. Zool. Soc., 1871, p. 473.

Bulimus junceus, Gould, Proc. Bost. Soc. Nat. Hist., 1846, p. 191; Ex. Ex. Shells, p. 76, fig. 87, Pfeiffer, Mon. Hel., ii. p. 220; iii. p. 400; iv. p. 462; vi. p. 100; viii. p. 138.

Stenogyra juncea, Mousson, Jour. de Conch., 1869, p. 340; 1870, p. 126; 1871, p. 15; 1873, p. 106. Pease, Jour. de Conch., 1871, p. 93; Proc. Zool. Soc., 1871, p. 473. (*Opeas*) Paetel, Cat. Conch., p. 104. Schmeltz, Cat. Mus. Godeff., v. p. 90. Garrett, Proc. Phil. Acad. Nat. Sci., 1879, p. 19.

Bulimus Walli, Cox, Cat. Aus. Land Shells, p. 24. Pfeiffer, Mon. Hel., vi. p. 99.

Stenogyra Upolensis, Mousson, Jour. de Conch., 1865, p. 175. (*Obeliscus*) Paetel, Cat. Conch., p. 104. Schmeltz, Cat. Mus. Godeff., iv. p. 29.

Bulimus Upolensis, Pfeiffer, Mon. Hel., vi. p. 100.

Stenogyra novemgyrata, Mousson, Jour. de Conch., 1870, p. 126. (*Subulina*) Paetel, Cat. Conch., p. 104. Schmeltz, Cat. Mus. Godeff., v. p. 90.

Bulimus novemgyratus, Pfeiffer, Mon. Hel., viii. p. 138.

Since I wrote my paper on Rurutu Land Shells I have made a more careful

study of Gould's *juncea* and the nearest allied species, the result of which, as will be observed, materially modifies the synonymy as given in that article.

As regards *Stenogyra Tuckeri*, I think there is not the least doubt of its being identical with Gould's *juncea*, which was published shortly after Pfeiffer's species.

Pfeiffer's description is as follows:—

"*T. perforata*, cylindraneo-subulata, tenuis, longitudinaliter distincte striata, nitidula, cerea; spira elongata, apice acutiuscula; aufr. 9 convexiusculi, ultimus $\frac{1}{4}$ longitudinis vix æquans; columella oblique recedens; apertura ovali-oblonga; perist. simplex, acutum, margine columellari superne dilatato, patente. Long. 9, diam. $2\frac{3}{4}$ mill., Ap. 2 mill. longa, $1\frac{1}{4}$ lata." (Pfeiffer.)

Burlimus junceus is thus described by Gould:—

"*T. parva*, elongato-conica, tenuis, translucida, dilute virens, concinne striata, vix perforata; spira ad apicem obtusa; anfr. 7 convexiusculi; superne contabulata; apertura elongato-ovata; labrum simplex, ad columellam vix reflexum. Long. $\frac{3}{10}$, lat. $\frac{1}{10}$ pol." (Gould.)

Dr. Gould's expression "*superne contabulata*" seems to have misled Prof. Mousson, who interpreted it to mean "*angulate*" or "*carinate*" instead of tumid, which induced him to redescribe it under the name of *S. upolensis*, as follows:—

"*T. perforata*, subulata, tenuis, subpellucida, striatula, cereo-cornea; spira conico-subulata, regularis; summo non minuto, obtusiusculo; sutura profunda. Anfr. 8, primi rotundati, sequentes satis in medio minus convexiusculi; ultimus $\frac{1}{4}$ longitudinis æquans, non descendens. Apertura subverticalis, oblongo-ovata. Perist. rectum, acutum; marginibus parallelis, recto de insertione antice arcuato, columellari reflexo. Columella recta, subpliciformis, linea fuscula colorata. Diam. $2\frac{1}{2}$, min. 2, altit. 10 mill. Rat. anfr. 4:1. Rat. apert. 5:3."

"Var. minor. Alt. 8 mill., fragilior, pallidior, lævior, columella concolore." (Mousson.)

With respect to the geographical range of *Tuckeri* it is recorded from Mangareva (= Gambier Islands), Tahiti, Guam, and Dr. Cox says it is generally diffused throughout Northeast Australia and the adjacent islands, as well as in the various islands in Southwest Polynesia. Mr. Brazier collected it on several islands in Torres' Straits, which gives it a range from east to west of over six thousand miles, or one-fourth the circumference of the globe. The former writer says it was introduced "to Sydney with plants from Aneiteum," one of the New Hebrides.

I have not the slightest doubt of its general diffusion throughout the East Indies, and it has been described from that region under other names. I will also add that it may extend its range to the islands off the east coast of Africa, or half the circumference of the globe.

I have now before me a dozen examples of Ceylon *Stenogyra*, which I received labelled *Bulimus gracilis*, Hutton. They comprise two species, one of which coincides in every character with our South Sea shells.

Prof. Moussen's *S. novemgyrata*, which I also add to the synonymy, is thus described:—

“T. obtecte subrimata, conico-turrita, tenuis, diaphana, striata, dilute virens. Spira regulariter spirata; summo obtusulo; sutura liniari impressa. Anfr. 9, sensim accrescentes, convexiusculi, ad suturam tumiduli et fortiter striati, sæpe tenuiter denudati; ultimus non descendens, media minus rotundatus, fere planus. Apert. $\frac{1}{4}$ altitudinis subæquans, paulo obliqua (20° cum axi) acute ovalis. Perist. rectum, acutum; marginibus distantibus; dextro medio antrorsum arcuatim producti; basali arcuatim retracto; columellari minime incrassato et appresso; columella oblique subplicata. Long. 13, diam. 3.2 mill. Rat. 5:1. Rat. apert. 7:5.” (Mousson.)

Having personally collected thousands of examples in nearly all parts of Polynesia, I find they vary in length, number and convexity of the whorls, development of striæ, more or less open columella chink, which is sometimes closed, and in color varies from whitish to pale greenish-horn color. In texture from thin pellucid, smooth shining to thick opaque cretaceous without lustre.

Prof. Mousson's elaborate descriptions are the most correct, and he is the only author who alludes to the subplicate columella.

They live under loose stones, beneath decaying wood and leaves, ranging from the sea-shore to over two thousand feet above sea-level.

GENUS PARTULA, Ferussac.

P. ASSIMILIS, Pease.

Partula assimilis, Pease, Amer. Jour. Conch., 1867, p. 230, Pl. 15, figs. 28–29; Jour. de Conch. 1870, p. 401; Proc. Zool. Soc., 1871, p. 473. Schmeltz, Cat. Mus. Godeff., v. p. 92. Pfeiffer Mon. Hel., viii. p. 197.

Partula Cookiana, (“Moussi.”) Paetel, Cat. Conch., p. 104.

Not uncommon on bushes in the higher portions of a few valleys on Rarotonga, where it is peculiar. In some valleys, where it was formerly abundant, it appears to have become extinct. My conclusions are based on the profusion of half decomposed shells scattered over the grounds, and not observing any living example.

The only variation is, some are more or less striped with light purple-brown and more rarely the peristome is stained with purple flesh color. The apex is more frequently dark reddish-brown or purple-black. In shape it is more nearly related to *P. clara*, a very rare Tahitian species, than to the common *varia* of

Huahine. The spire is more robust than in either of those species, and in that respect makes a nearer approach to the Tongan *subgonochila*, which is smaller and more solid.

P. HYALINA, Broderip.

Partula hyalina, Brod., Proc. Zool. Soc., 1832, p. 32. Muller, Syn., p. 32. Reeve, Conch. Syst., ii., Pl. 175, figs. 1-2. Jay, Cat. Shells (1839), p. 57. Reeve, Conch. Icon., Pl. 3, fig. 14, Pfeiffer, Mon. Hel., iii. p. 451; iv. p. 510; vi. p. 159; viii. p. 198. Pease, Proc. Zool. Soc., 1871, p. 473. Paetel, Cat. Conch., p. 104. Schmeltz, Cat. Mus. Godeff., v. p. 92. Garrett, Proc. Phil. Acad. Nat. Sci., 1879, p. 18.

Bulinus hyalinus, Sow., Conch. Ill., fig. 9.

Bulimus hyalinus, Lam., Ed. Desh., p. 284. Pfeiffer, Mon. Hel., ii. p. 67.

Partutus hyalinus, Beck, Ind., p. 57.

This well-known species, which has its metropolis or specific centre in the Austral Islands, also inhabits Mangaia four hundred miles west of the former group. It is also distributed in limited numbers in every valley on Tahiti, which is three hundred miles north of its metropolis.

With the exception of the *Auriculidæ*, it is the *only* species of Polynesian land shells of its size common to two or three distant groups of islands.

As the above statement does not harmonize with the distribution of the various species of Polynesian shells as recorded by different authors, I will add, that in Dr. Pfeiffer's last volume of his "Monographia Heliciorum," where he enumerates seventy-seven species of Polynesian (I exclude the Melanesian and Pelew species) *Partula*, there exist twenty-six errors in localities, or a fraction less than one-third!! In Reeve's Monograph of the same genus, where he records twenty-five species, there are seven wrong localities.

In Paetel's Catalogue of fifty-one species of *Partula*, over one-fourth of the localities are erroneous. In Mr. Pease's list of Polynesian land shells, where he enumerates sixty-five species, including his two *Bulimi*, there are eight wrong habitats given.

All the species, which are diffused over one or more groups, are *invariably* minute shells. The same law obtains in the distribution of the minute species of Europe and North America, some of which extend their range over large portions of the three continents, and have even migrated into the tropics.

This solitary exception to the general law which governs the distribution of the larger species in Polynesia, is the more remarkable from the fact that the two remote islands where it occurs are the ones nearest to its metropolis, and the species has not spread to any of the neighboring islands in either group.

Now, it would be most interesting to ascertain how this migration has been effected. It cannot, I think, be attributed to human agency, for the simple reason that in the Society Group, where the islands are not very far apart, the natives are almost daily conveying fruits and vegetables from one to another, and have probably done so for hundreds of years; yet *not one* species of *Partula* has been introduced from one island to another through their agency. Moreover, the general diffusion of *hyalina* over Tahiti, which exceeds that of any of its endemic species, is opposed to the human agency theory.

As stated in my paper on the Rurutu shells, migration might have taken place in some remote period when land communication existed between the three islands. But the most serious objection to this hypothesis is, if the Tahitian endemic species were contemporary at the time of migration, some would probably have extended their range so far to the southward and westward, that, when communication was interrupted by the subsidence of the land, some of their descendants would have been found at this day either on Magaia or the Austral Islands.

The existence of several genera and numerous species of marine shells in the above island, which do not occur on the Tahitian coast, are opposed to the above theory. The avifauna of the islands is also unfavorable to the hypothesis.

The hypothesis of independent creation of the same species in different places, I do not feel competent to discuss; but will leave it to others who are better qualified to elucidate the difficult problem.

Examples of *hyalina* from the three distant localities are precisely alike; proving that food, temperature, and difference in station have not developed a single varietal character to distinguish the species of the different groups. The local variation, which is exactly the same throughout its range, is so slight as not to be worthy of notice.

GENUS TORNATELLINA, Beck.

T. PHILIPPII, Pfeiffer.

Tornatellina Philippii, Pfeiffer, Zeitsch. Malak., 1849, p. 93; Mon. Hel., iii. p. 524; iv. p. 651; vi. p. 263; viii. p. 317. Pease, Proc. Zool. Soc., 1871, p. 473. Garr., Proc. Phil. Acad. Nat. Sci. p. 22.

Pupa Philippii, Kuster, Pl. 18, fig. 20, 21.

Leptinaria Philippii, H. & A., Adv. Gen. Moll., p. 141.

Achatina Philippii (*Leptinaria*), Pfeiffer, Vers., p. 170.

Cionella Philippii, Martens.

A few examples of this species were found under decaying leaves in forests near the sea-shore at Aitutaka. It also occurs, but not plentiful, in the Austral, Society, and Marquesas Islands.

It can readily be distinguished by its swollen body, rounded whorls, prominent thin parietal lamina, and somewhat twisted columella, which in young examples is biplicate.

T. OBLONGA, Pease.

Tornatellina oblonga, Pease, Proc. Zool. Soc., 1864, p. 673; Jour. de Conch., 1871, p. 93; Proc. Zool. Soc., 1871, p. 473. Pfeiffer, Mon. Hel., vi. p. 264; viii. p. 317; Schmeltz, Cat. Mus. Godeff., v. p. 89. Garr., Proc. Phil. Acad. Nat. Sci., 1879, p. 21.

Tornatellina bacillaris, Mousson, Jour. de Conch., 1871, p. 16, Pl. 3, fig. 5. Pfeiffer, Mon. Hel., viii. p. 316. Schmeltz, Cat. Mus. Godeff., v. pp. 89, 90.

This species is widely diffused over all the groups in Southeastern Polynesia, and ranges west as far as the Samoa and Tonga Islands. Like all the species of this type it lives on the ground, generally concealed beneath dead wood and decaying leaves, ranging from the low-lands near the sea-shore to two thousand or more feet above sea-level.

Mr. Pease's type specimens were collected by me at the Society Isles. Prof. Mousson gives a most excellent description of this species under the name of *bacillaris*, collected by Dr. Graffe, in the Samoa Group.

Its slender form and nearly vertical, simple columella will easily distinguish it.

T. PERPLEXA, Garrett.

Tornatellina perplexa, Garr., Proc. Phil. Acad. Nat. Sci., 1879, p. 24.

Tornatellina bilamellata, Schmeltz (not of Anton), Cat. Mus. Godeff., v. p. 90.

So far as known this species is confined to the Cook's, Austral, and Society Islands, where it is not uncommon in the low-land forests.

Though shaped like *T. nitida*, it may be determined by its more flattened and bidentate columella, larger, and more oblique parietal lamina. Anton's *bilamellata*, which inhabits "Opara" = Rapa, is twice the size of our shell, and, according to the description, has a smaller plait on the wall of the aperture, and is destitute of the palatal dentacles.

T. SIMPLEX, Pease.

Tornatellina simplex, Pease, Proc. Zool. Soc., 1864, p. 673; 1871, p. 473. Pfeiffer, Mon. Hel., vi. p. 266; viii. p. 319. Garr., Proc. Phil. Acad. Nat. Sci., 1879, p. 22.

Plentiful in all parts of the group, and is also diffused throughout the Austral, Society, and Marquesas Islands.

Mr. Pease's type specimens were collected by me at Tahaa, one of the Society Islands. He either overlooked or inadvertently omitted to mention the small but constant parietal lamina in his brief diagnosis. He mentions only five whorls, and states that the last one equals half the length of the shell. There are six whorls

in the numerous examples before me, and the last one equals about one-third the length of the shell.

The open umbilicus, small parietal lamina, and simple columella are its most obvious characters, and will distinguish it at once from any other South Polyneesian species.

T. SERRATA, Pease.

Lamellina serrata, Pease, Proc. Zool. Soc., 1860, p. 439; 1871, p. 473.

Lamellina lævis, Pease, Proc. Zool. Soc., 1864; 1871, p. 473.

Tornatellina serrata, Pfeiffer, Mon. Hel., vi. p. 265; viii. p. 319. Garrett, Proc. Phila. Acad. Nat. Sci., 1879, p. 25.

Tornatellina lævis, Pfeiffer, Mon. Mel., vi. p. 266; viii. p. 319.

Not uncommon in the low-land forests near the sea-shore, and ranges throughout the group.

It also occurs in the Austral and Society Islands, and probably extends its range through the small islands in "Central Pacific" to the Marshall or Caroline Group, where I obtained Mr. Pease's type specimens of *serrata*.

Its ovate-conic form, swollen whorls, acute columellar tooth, and the longitudinal, smooth, or serrated laminæ in the palate will easily distinguish it.

For further remarks on the synonymy of this species, and observations on Mr. Pease's genus *Lamellina*, see my paper on the Rurutu Land Shells.

T. NITIDA, Pease.

Tornatellina nitida, Pease, Proc. Zool. Soc., 1860, p. 439; Jour. de Conch., 1871, p. 93; Proc. Zool. Soc., 1871, p. 473. Pfeiffer, Mon. Hel., vi. p. 264; viii. p. 317. Garrett, Proc. Phil. Acad. Nat. Sci., 1879, p. 22.

Abundant in all parts of the group, and ranges from the Paxmotus to the Caroline Islands.

A thin transparent species with a more tapering spire than *oblonga*, with the twisted columella of *conica*, but distinguished from either by the acute tooth-like plication on the columella.

For further remarks see my paper on the Rurutu Land Shells.

T. CONICA, Mousson.

Tornatellina conica, Mousson, Jour. de Conch., 1869, p. 342, Pl. 14, fig. 8; 1870, p. 128; 1871, (var. *impressa*), p. 16; 1873, p. 106. Pease, Proc. Zool. Soc., 1871, p. 473. Pfeiffer, Mon. Hel., viii. p. 316. Garrett, Proc. Phil. Acad. Nat. Sci., 1879, p. 21. Schmeltz, Cat. Mus. Godeff., v. p. 89.

Cionella conica, Paetel, Cat. Conch., p. 106.

Tornatellina oblonga, Pease (Part), Proc. Zool. Soc., 1864, p. 673.

This species, which is rather abundant, is diffused throughout all the groups in Southern Polynesia, ranging west to the Viti Islands.

It is more robust and lighter colored than *oblonga*, and the spire is more tapering, body whorl larger, more depressed, parietal lamina more prominent, and the columella more twisted.

GENUS VERTIGO, Muller.

V. PEDICULUS, Shuttleworth.

Pupa pediculus, Shutt., Bern. Mitth., 1852, p. 296. Pfeiffer, Mon. Hel., iii p. 557; iv. p. 684; vi. p. 330; viii. p. 402. Schmeltz, Cat. Mus. Godeff, v. p. 89. Mousson (var. *samoensis*), Jour. de Conch., 1865, p. 175.

Vertigo pediculus, Pfeiffer, Vers., p. 177. (*Alæa*) H. & A. Ads., Gen. Moll., p. 172. Mousson, Jour. de Conch., 1869, p. 341; 1870, p. 127; 1871, p. 15; 1873, p. 106. Pease, Proc. Zool. Soc., 1871, pp. 463, 474. Garrett, Proc. Phil. Acad. Nat. Sci., 1879, p. 19.

Pupa samoensis, "Mss." Schmeltz, Cat. Mus. Godeff, iv. p. 69. (*Sphyradium*) Paetel, Cat. Conch., p. 108.

Pupa nitens, Pease, Proc. Zool. Soc., 1860, p. 439. Pfeiffer, Mon. Hel., vi. p. 335; viii. p. 407.

Vertigo nitens, Pease, Proc. Zool. Soc., pp. 463, 474.

Pupa hyalina, "Zeilebor," Pfeiffer, Mon. Hel., v. p. 329; viii. p. 401.

Vertigo hyalina, Pease, Proc. Zool. Soc., 1871, p. 474.

? *Vertigo nacca*, Gould, Proc. Bost. Soc. Nat. Hist., 1862, p. 280; Otia Conch., p. 237. Pease, Proc. Zool. Soc., 1871, pp. 463, 474.

Pupa nacca, Pfeiffer, Mon. Hel., vi. p. 330; viii. p. 402.

With the exception of *Stenogyra Tuckeri*, this minute species has the widest range of any other Polynesian land shell.

For further information in regard to the history and variations of this species see my paper on the Rurutu Land Shells, published in the Academy's Proceedings.

V. TANTILLA, Gould.

Pupa (Vertigo) tantilla, Gould, Proc. Bost. Soc. Nat. Hist., 1847, p. 197. Pfeiffer, Mon. Hel., iii. p. 557; iv. p. 684; vi. p. 330; viii. p. 402. (*Vertigo*) Mousson, Jour. de Conch., 1870, p. 127. (*Vertigo*) Schmeltz, Cat. Mus. Godeff, iv. p. 69; v. p. 89. (*Pupilla*) Paetel, Cat. Conch., p. 108.

Vertigo tantilla, Gould, Ex. Ex. Shells, p. 92, Pl. 7, fig. 103. (*Alæa*) H. & A. Ads., Gen. Moll., p. 172. Pease, Proc. Zool. Soc., 1871, pp. 460, 463, 474.

Pupa Dunkeri, "Zeilebor," Pfeiffer, Mon. Hel., vi. p. 333; viii. p. 401.

Vertigo Dunkeri, Pease, Proc. Zool. Soc., 1871, p. 474.

Vertigo armata, Pease, Proc. Zool. Soc., 1871, p. 261, 474.

Pupa armata, Pfeiffer, Mon. Hel., viii. p. 407.

Vertigo dentifera, Pease, Proc. Zool. Soc., 1871, pp. 462, 474.

Pupa dentifera, Pfeiffer, Mon. Hel., viii. p. 408.

This species appears to be widely diffused throughout Southern Polynesia;

but, owing to their diminutive size and dark color, are not easily detected in the gloomy forests, unless especially sought for. They occur beneath rotten wood, but more frequently in the cells and fissures of basaltic rocks, and range from the low-land forests to over two thousand feet above sea level.

Dr. Gould's type specimens were collected at Tahiti, where I also gathered numerous examples, as well as at Huahine, Borabora, and Maupiti, in the same group. Dr. Graffe found it at the Viti Islands, and Paetel records it from Samoa.

Mr. Pease's type specimens of *armata* were collected by me at Borabora, and his *dentifera* I found in forests near the sea-shore at Aitutaki, not "Rarotonga."

Zeilebor's *Dunkeri*, which is very accurately described, was obtained at Tahiti, during the voyage of the "Novara," and, together with Mr. Pease's two species, are identically the same as *tantilla*, which is subject to considerable variation.

In shape they vary from an abbreviate-ovate to oblong-oval, and still more so in the relative proportion of the whorls. Some have them slowly and regularly increasing, giving the outlines a subcylindrical form. Others have the two last whorls abruptly enlarged, and both of the same diameter, whilst some have the penultimate exceeding in diameter the body whorl.

The color is pale corneous under a brownish, more or less distinctly shagreened epidermis, which, in perfect examples, is furnished with distant oblique, deciduous, membranous ribs, which, when viewed laterally, are frequently whitish, as mentioned by Pease in his description of *armata*.

The last whorl, behind the peristome, is more or less conspicuously bisulcate in the majority of specimens. The lip, which is darker colored than the epidermis, is usually emarginate near the suture, and in old examples is thick and flat.

They vary considerably in the number of teeth in the aperture. There are two on the parietal region, which are elongate, more or less curved, and one is frequently united to the outer lip. Sometimes there exists a third and smaller one more deeply seated near the columella. The teeth in the palate vary the same as in *pediculus*.

GENUS SUCCINEA, Draparnaud.

S. COSTULATA, Pease.

Succinea costulata, Pease, Proc. Zool. Soc., 1864, p. 677; 1871, p. 472. Pfeiffer, Mon. Hel., v., p. 31; vii., p. 40.

I found two examples of this well-marked species in a lot of land shells collected for me at Aitutaki. They were the only specimens of the genus obtained whilst exploring the group, and differed none from Tahitian examples.

Its small size, abbreviate form, and plicate striæ are its most obvious characters.

GENUS LIMAX, Linnæus.

L. RAROTONGANUS, Heynemann.

Limax Rarotonganus, Heyn., Nach. Malak Gesell., 1871, p. 43. Schmeltz, Cat. Mus. Godeff., v, p. 96.

Very abundant in damp places in the mountain ravines on Rarotonga. It is probably identical with a Tahitian species.

GENUS MELAMPUS, Montfort.

M. LUTEUS, Quoy and Gaimard.

Auricula lutea, Q. et G., Voy. Astrol., ii., p. 163, Pl. 13, figs. 25-27. Deshayes, in Lam. Hist., viii., p. 338. Kuster, Auric., p. 39, Pl. 6, figs. 1-3. Reeve, Conch. Syst., ii., Pl. 187, fig. 11. Mousson, Jav. Moll., p. 47, Pl. 5, fig. 6.

Melampus luteus, Beck, Ind., p. 106. M. E. Gray, Fig. Moll. Anim., Pl. 306, fig. 5. H. & A., Ads., Proc. Zool. Soc., 1854, p. 10; Gen. Moll., ii., p. 243. Pfeiffer, Syn. Auric., No. 30. Moreh, Cat. Yold., p. 38. Pfeiffer, Mon. Auric., i., p. 36. Mousson, Jour. de Conch., 1869, p. 346; 1870, p. 134; 1873, p. 106. Martens & Langk., Don. Bism., p. 55. Gassies, Faun. Nouv. Caledonia, p. 62. Pease, Jour. de Conch., 1871, p. 93; Proc. Zool. Soc., 1871, p. 477. Paetel, Cat. Conch., p. 114. Schmeltz, Cat. Mus. Godeff., v., p. 88. Garrett, Proc. Phil. Acad. Nat. Sci., 1879, p. 28.

Conovulus luteus, Anton, Verz., p. 48.

Very abundant in all parts of Polynesia, except the Marquesas and Sandwich Islands. It also extends its range throughout Melanesia and the East Indies.

The only variation is in size and depth of color; it is never banded.

They are found beneath loose stones and drift-wood, a little above high-water mark.

The animal is very pale, luteous gray, with dusky-gray tentacles. The hinder termination of the foot is fissured or bifid and grooved above.

M. FASCIATUS, Deshayes.

Auricula fasciata, Desh., Encycl. Meth., ii., p. 90; in Lam. Hist., viii., p. 337. Kust. Auric., Pl. A, figs. 2-3. Mousson, Jav. Moll., p. 46, Pl. 5, figs. 28-29.

Auricula monile, Quoy et Gaimard, Voy. Astrol., ii., p. 166, Pl. 13, figs. 28-33. Potiez & Michaud, Gal. Douai, i., p. 202. Reeve, Conch. Syst., ii., Pl. 187, fig. 8.

Melampus fasciatus, Beck, Ind., p. 107; (*Tralia*) H. & A. Adams, Proc. Zool. Soc., 1854, p. 11. Pfeiffer, Syn. Auric., No. 30; Mon. Auric., i., p. 38; Mon. Pneum., Suppl. 3 (Auric.), p. 310. Mousson, Jour. de Conch., 1869, p. 348; 1870, p. 135. Pease, Jour. de Conch., 1871, p. 93; Proc. Zool. Soc., 1871, p. 477. Martens & Langk., Don. Bism., p. 55. Paetel, Cat. Conch., p. 114. Schmeltz, Cat. Mus. Godeff., p. 88.

Melampus Philippii, Mousson (not of Kuster), Jour. de Conch., 1869, p. 348.

Conovulus fasciatus, Griff., Cuv. Anim. King., Pl. 27, fig. 13. Anton, Verz., p. 48. Guerin, Icon. Moll., p. 17, Pl. 7, fig. 8.

Cassidula? monilis, M. E. Gray, Fig. Moll. Anim., Pl. 306, figs. 10-11.

Tralia (Pira) fasciata, H. & A. Adams, Gen. Moll., p. 244.

Like the preceding species this lives just above high-water mark, and, excepting the Gambier's, has the same extensive geographical range.

The animal is pale grayish with dusky tentacles. The foot is the same as in *luteus*.

They vary more or less in the convexity of the last whorl, and the small plicæ on the spire is either very conspicuous or faint, and is sometimes confined to the whorls near the apex. The base is occasionally obliquely striate as in *Philippii*.

It is subject to considerable variation in color and fasciation. The ground color in the type varies from pale bluish-white to luteous, and the bands range from four to six.

The following varieties occur:—

- a.* Uniform bluish-white, corneous, luteous, and brownish or yellowish-brown.
- b.* Yellowish-brown with three chestnut-brown bands.
- c.* Yellowish-brown with chestnut-brown base and spire.
- d.* Olive-gray with three bluish-white bands.

Variety *b* and *c*, which are larger and more robust than the type, only occurred to my notice in the Samoa, Tonga, and Viti Islands.

Prof. Mousson's *Philippii*, not of Kuster, I do not hesitate to refer to *fasciata*. I collected many thousands of *Melampi* in various parts of Samoa, Tonga, and Viti Islands, but did not find one of Kuster's species, which appears to be confined to Southeast Polynesia.

GENUS LAIMODONTA, Nuttall.

L. CONICA, Pease.

Laimodonta conica, Pease, Proc. Zool. Soc., 1862, p. 242; Amer. Jour. Conch., 1868, p. 101, Pl. 12, fig. 15; Jour. de Conch., 1871, pp. 93, 94; Proc. Zool. Soc., 1871, pp. 470, 477. Schmeltz, Cat. Mus. Godeff, v., p. 87.

Læmodonta conica, Martens & Langk. Don. Bism., p. 57, Pl. 3, fig. 13.

Laimodonta Anaaensis, Mousson, Jour de Conch., 1869, p. 63, Pl. 5, fig. 1.

Plecotrema Anaaensis, Paetel, Cat. Conch., p. 114.

? *Melampus conicus*, Pfeiffer, Mon. Pneum., Suppl. 3 (Auricul.), p. 319.

? *Melampus Anaaensis*, Pfeiffer, l. c., p. 320.

This species, of which a single example was found at Rarotonga, ranges from the Paumotus to the Viti Islands. Mr. Pease records it from "Central Pacific." It is rarely found alive.

It is smaller and not so robust as *L. Bronni* of the Sandwich Islands. The spiral impressed lines are more conspicuous, and the aperture exhibits a heavier deposit of callus in the palate.

GENUS DIADEMA, Pease.

D. PARVA, Pease.

Pterocyclos? parva, Pease, Amer. Jour. Conch., 1865, p. 290; 1866, p. 82, Pl. 5, fig. 8.

Diadema parva, Pease, Amer. Jour. Conch., 1868, p. 158, Pl. 12, fig. 13 (Operculum); Proc. Zool. Soc., 1871, p. 475. Pfeiffer, Mon. Pneum., Suppl. 3, p. 56.

Pterocyclos (Diadema) parvus, Mart. & Langk. Don. Bism., p. 58.

Garrettia parva, Paetel, Cat. Conch., p. 124. Schmeltz, Cat. Mus. Godeff., v., p. 100.

Found in the greatest profusion on the ground in forests at Aitutaki, where it appears to be peculiar.

Its turbinate form, brown color, and quadricarinate body-whorl will readily distinguish it.

All of Mr. Pease's specimens were collected by me, and though the locality was well known to him, yet from some unaccountable reason he suppressed the locality of this, and most of the other new species he received of me. When he published the genus *Diadema* he gave the correct locality of this species, but in his list of Polynesian land shells refers it to Rarotonga where it does not occur.

D. BIANGULATA, Pease.

Cyclostoma biangulatum, Pease, Proc. Zool. Soc., 1864, p. 674.

Diadema biangulata, Pease, Proc. Zool. Soc., 1871, p. 475. Pfeiffer, Mon. Pneum., Suppl. 3, p. 56.

Cyclophorus (Ostodes) biangulatus, Martens & Langk., Don. Bism., p. 58, Pl. 3, fig. 16.

Garrettia scalariformis, Paetel, Cat. Conch., p. 124.

Garrettia biangulata, Schmeltz, Cat. Mus. Godeff., v., p. 100.

? *Cyclophorus biangulatus*, Pfeiffer, Mon. Pneum., Suppl. 3, p. 114.

? *Cyclomorpha biangulata*, Pfeiffer, l. c., p. 234.

Found in equal abundance, and associated with the preceding species, but not obtained in any other part of the group. Mr. Pease's habitat "Atiu," as given in his "List of Polynesian Land Shells," is entirely gratuitous. He received the specimens of me carefully labelled Aitutaki.

Had the above author included it in his list of *Diadema* when he first published the genus, the doubts and confusion in regard to its generic position would have been avoided.

His type specimens were collected by me at Moorea, one of the Society Islands, where I found a single small colony, probably introduced. When he described it he gave the vague locality "Central Pacific."

It differs from *parva* in its more elongate shape and tricarinate body-whorl.

D. ROTELLA, Pease.

Diadema rotella, Pease, Amer. Jour. Conch., 1868, p. 158, Pl. 12, fig. 13; Proc. Zool. Soc., 1871, p. 475. Pfeiffer, Mon. Pneum., Suppl. 3, p. 56.

Pterocyclos (Diadema) rotella, Paetel, Cat. Conch., p. 119.

Garrettia rotella, Schmeltz, Cat. Mus. Godeff., v., p. 100.

Not uncommon on the ground in forests at Rarotonga, and as near as I can ascertain is peculiar to that island. When Mr. Pease first described it he gave "Atiu" as its habitat; but in his List of Polynesian Land Shells he correctly refers it to Rarotonga.

It can readily be distinguished by its smooth rounded whorls.

GENUS OMPHALOTROPIS, Pfeiffer.

O. OCHROSTOMA, Pease.

Realia ochrostoma, Pease, Amer. Jour. Conch., 1865, p. 287; 1866, p. 82, Pl. 5, fig. 1. Martens & Langk., Don. Bism., p. 59, Pl. 3, fig. 19. Pfeiffer, Mon. Pneum., Suppl. 3, p. 224.

Omphalotropis ochrostoma, Pease, Jour. de Conch., 1869, p. 147. Schmeltz, Cat. Mus. Godeff., v., p. 101.

Omphalotropis ochroleuca, "Pease," Paetel, Cat. Conch., p. 124.

Atropis ochrostoma, Pease, Proc. Zool. Soc., 1871, p. 476.

Hydrocena ochrostoma, Paetel, Cat. Conch., p. 124.

I gathered hundreds of examples of this species in the low-land forests of Aitutaki.

Though referred by Pease to his subgenus *Atropis*, the base, nevertheless, exhibits a rather conspicuous keel, and very rarely with a periphery carination. The vertical aperture is more frequently white than ochraceous. The whorls, which are separated by a deep suture, vary from five to six. Adults are decorticated and usually more or less eroded. They show considerable variation in color; white, corneous, pale luteous, and ruddy-brown.

O. VARIABILIS, Pease.

Realia variabilis, Pease, Amer. Jour. Conch., 1865, p. 288; 1866, p. 82, Pl. 5, fig. 2. Martens & Langk., Don. Bism., p. 59, Pl. 3, fig. 18. Pfeiffer, Mon. Pneum., Suppl. 3, p. 227.

Omphalotropis variabilis, Pease, Jour. de Conch., 1869, p. 124; Proc. Zool. Soc., 1871, p. 476. Paetel, Cat. Conch., p. 124. Schmeltz, Cat. Mus. Godeff., v., p. 101.

This species is probably distributed throughout the group. I obtained it in abundance at all the islands I explored.

It may be distinguished from the preceding by its less variable color, more produced spire, more conspicuous basal keel, and the constant carination on the periphery. Though decorticated it is never eroded, and the surface is smoother, more shining, and the suture is more deeply incised. The vertical aperture is always whitish. Whorls six.

O. OVATA, Pease.

Hydrocena ovata, Pease, Proc. Zool. Soc., 1864, p. 674.

Omphalotropis ovata, Pease, Jour. de Conch., 1869, p. 148; Proc. Zool. Soc., 1871, p. 476.

Realia ovata, Pfeiffer, Mon. Pneum., Suppl. 3, p. 212.

I include this species on the authority of Mr. Pease, who found it in a small lot of land shells collected by Dr. Dean at Mangaia.

GENUS SCALINELLA, Pease.

S. AFFINIS, Pease.

Realia affinis, Pease, Amer. Jour. Conch., 1865, p. 288; 1866, p. 82, Pl. 5, fig. 4. Pfeiffer, Mon. Pneum., Suppl. 3, p. 218.

Omphalotropis affinis, Pease, Jour. de Conch., 1869, p. 152.

Atropis affinis, Pease, Proc. Zool. Soc., 1871, p. 476.

Scalinella affinis, Martens & Langk., Don. Bism., p. 59. Paetel, Cat. Conch., p. 124. Schmeltz, Cat. Mus. Godeff., v. p. 102.

Common on the ground in forests near the sea-shore at Aitutaki.

Though referred by Mr. Pease to his genus or subgenus *Atropis*, it should, I think, be embraced in *Scalinella*. In the above author's description he says, "*longitudinally indistinctly plicately-ribbed; ribs close and somewhat oblique*," and "*the above two species together with R. costata (Pease) and R. Tahitensis (Pease) form a group in being ribbed longitudinally*."

In the numerous examples now before me the ribs gradually fade away, so that some specimens are perfectly smooth and undistinguishable from *Atropis*. It may be considered an intermediate form connecting the two genera the same as certain species of *Atropis* graduate into *Omphalotropis*.

S. SCALARIFORMIS, Pease.

Realia scalariformis, Pease, Amer. Jour. Conch., 1865, p. 288; 1866, p. 82, Pl. 5, fig. 3. Pfeiffer, Mon. Pneum., Suppl. 3, p. 217.

Scalinella scalariformis, Pease, Jour. de Conch., 1869, p. 159; Proc. Zool. Soc., 1871, p. 476. Martens & Langk., Don. Bism., p. 59. Schmeltz, Cat. Mus. Godeff., v., p. 102.

Not uncommon on the ground in forests near the sea-shore at Atiu.

Dr. Pfeiffer, misled by the wrong localities in the "American Journal of Conchology" for 1866, page 82, has confused the habitat of this species with that of *Palaina scalariformis*, Pease. The latter does not occur at the "Harvey Isles," as quoted by that author, neither does the species under consideration inhabit "Oulan" = Ponape.

It differs from the preceding species in its larger constant ribs and more projected body-whorl. The color is also darker.

GENUS HELICINA, Lamarck.

H. PARVULA, Pease.

Helicina parvula, Pease, Amer. Jour. Conch., 1868, p. 156, Pl. 12, fig. 10; Proc. Zool. Soc., 1871, p. 476. Paetel, Cat. Conch., p. 125. Schmeltz, Cat. Mus. Godeff., v., p. 99. Pfeiffer, Mon. Pneum., Suppl. 3, p. 249.

This minute species is exceedingly abundant on all the islands, where it occurs on the ground in forests.

The only variation is in color, which, though usually pale corneous, is frequently reddish-brown, and sometimes varied with a sutural and basal reddish band.

H. FLAVESCENS, Pease.

Helicina Pacifica, Pease, Amer. Jour. Conch., 1865, p. 291; 1866, p. 82, Pl. 5, fig. 7.

Helicina flavescens, Pease, Amer. Jour. Conch., 1867, p. 228, Pl. 15, fig. 25; Proc. Zool. Soc., 1871, pp. 467, 476. Schmeltz, Cat. Mus. Godeff., v., p. 99. Pfeiffer, Mon. Pneum., Suppl. 3, p. 260.

Helicina pisum, Hombr. & Jacq. (not of Philippi), Voy. Pol. Sud., v. p. 44, Pl. 11, figs. 18-22; Pfeiffer, Mon. Pneum., Suppl. 2, p. 185.

Helicina straminea, Pease, MS. Schmeltz, Cat. Mus. Godeff., v. p. 99.

Helicina Tahitensis, Pease, Proc. Zool. Soc., 1871, pp. 466, 476. Schmeltz, Cat. Mus. Godeff., v. p. 98. Pfeiffer, Mon. Pneum., Suppl. 3, p. 256.

This, like the preceding species, is distributed throughout the group, and is strictly confined to the low-lands near the sea-shore, where they occur in prodigious numbers on stony ground.

The locality "Oulan Isl'd," as given in the "American Journal of Conchology," is erroneous.

Pease's *Tahitensis*, which we add to the synonymy of this species, is also diffused throughout the Society Islands, and, like *flavescens*, delights in stony grounds in close proximity to the sea.

Both have the exceedingly delicate fugacious striæ, but this is much more rarely seen on Tahitian examples. It is not by any means a constant character in *flavescens*, and the clean smooth shells cannot be distinguished from *Tahitensis* by a single constant feature. Both vary in the outline of the periphery, which is either rounded or more or less angulate, but *never* carinate.

H. Brazieri, Pease, which inhabits Savage Island, is smaller, more variable in color, frequently banded, and is slightly carinate.

GENUS CHONDRELLA, Pease.

Since the publication of my paper on the Rurutu land shells, I have again restudied with great care the animals of several examples of this genus, and the results fully confirm my previous statement in regard to the total absence of tentacles or eye-"lumps."

In every other respect the animal differs none from *Assimineæ*, except in having a shorter muzzle.

The genus is confined to Southeastern Polynesia.

C. STRIATA, Pease.

Chondrella striata, Pease, Proc. Zool. Soc., 1871, p. 477. Pfeiffer, Mon. Pneum., Suppl. 3, p.

294. Garrett, Proc. Phil. Acad. Nat. Sci., 1879, p. 28.

Hydrocena striata, Schmeltz, Cat. Mus. Godeff., v. p. 100.

Hydrocena subinsularis, Mousson, MS.

These minute shells are plentiful in all parts of the group.

For further information in regard to this species see my paper on the Rurutu land shells, published in the Proceedings of the Academy.

GENUS ASSIMINEA, Leach.

The animal of *A. nitida*, which is nearly colorless, has a small oval foot, rather broad head, prominent, transversely wrinkled muzzle, which is dilated and bilobed in front. The conspicuous black eyes are nearly terminal on short, stout, conical tentacles. Locomotion is effected by the aid of the very mobile muzzle.

The position of the eyes proves the correctness of Mr. Pease's views in regard to the separation of this and many other species from *Omphalotropis* and *Hydrocena*, and uniting them to *Assimineea*.

A. NITIDA, Pease.

Hydrocena nitida, Pease, Proc. Zool. Soc., 1864, p. 674.

Assimineea nitida, Pease, Jour. de Conch., 1869, p. 165, Pl. 7, fig. 11; Proc. Zool. Soc., 1871, p.

476; Schmeltz, Cat. Mus. Godeff., v. p. 103. Garr., Proc. Phil. Acad. Nat. Sci., 1879, p. 29.

? *Realia nitida*, Pfeiffer, Mon. Pneum., Suppl. 3, p. 212.

Hydrocena parvula, Mousson, Jour. de Conch., 1865, p. 184; 1873, p. 108.

Omphalotropis parvula, Pease, Jour. de Conch., 1869, p. 155; Proc. Zool. Soc., 1871, p. 476.

Paetel, Cat. Conch., p. 124.

Assimineea parvula, Pease, Proc. Zool. Soc., 1871, p. 476. Schmeltz, Cat. Mus. Godeff., v. p. 103.

Realia parvula, Pfeiffer, Mon. Pneum., Suppl. 3, p. 213.

Assimineea lucida, Pease, Jour. de Conch., 1869, p. 166, Pl. 7, fig. 10; Proc. Zool. Soc., 1871, p. 476.

Assimineea ovata, "Pease," Schmeltz, Cat. Mus. Godeff., v. p. 103.

Hydrocena similis, Baird, Cruise of the Curacoa.

This small, obscure species is generally distributed throughout Southern Polynesia, and ranges from near the sea-shore to about two thousand feet above sea-level. They are found beneath decaying leaves, under stones and dead wood, associated with minute *Helices* and other small species of land shells.

I found Mr. Pease's type examples of *lucida* in beach sand at Anaa, Paumotu Islands. They were worn and discolored by salt water. Living shells, which I subsequently obtained in the same locality, were undistinguishable from his *nitida*. Adolescent specimens have the body-whorl slightly angulate near the suture.

The only variation is in size, more or less elevated spire, and the color varies from light to dark corneous, rarely with an obscure band on the last whorls.

They can scarcely be distinguished from *A. Californica*, except in being lighter colored, and the spire more planulate in outline. *A. Vitiensis* is larger, much darker colored, and always banded, the spire more convex, and inhabits brackish-water swamps.

It is surprising that Mr. Pease, when he published his Monographs of *Omphalotropis* and *Assimineæ*, should have referred Mousson's *parvula* to the former genus. And in his list of Polynesian land shells he commits a graver fault by including it in both genera.

RECAPITULATION.

The following list and columns will exhibit, at a glance, the distribution of the land shells over the four islands explored by me:—

						Rarotonga.	Aitutaki.	Atiu.	Mangaia.
1.	<i>Microcystis</i>	<i>excrecens</i> , Mouss.	.	.	.	X	..	..	..
2.	"	<i>subcicercula</i> , Mouss.	.	.	.	X	..	..	..
3.	"	<i>venosa</i> , Pease	.	.	.	X	..	..	..
4.	"	<i>Discoidiæ</i> , Garr.	.	.	.	X	X	X	X
5.	"	<i>conula</i> , Pease.	.	.	.	X	..	..	..
6.	"	<i>Samoensis</i> , Mouss.	.	.	.	X	..	..	..
7.	<i>Patula</i>	<i>tenuicostata</i> , Garr.	.	.	.	X	..	..	..
8.	"	<i>canalis</i> , Garr.	.	.	.	X	..	..	..
9.	"	<i>Atiensis</i> , Pease	.	.	.	..	X	X	..
10.	"	<i>proxima</i> , Garr.	.	.	.	X	..	..	..
11.	"	<i>rudis</i> , Garr.	.	.	.	X	..	..	..
12.	"	<i>decorticata</i> , Garr.	.	.	.	X	..	..	..
13.	"	<i>Harveyensis</i> , Garr.	.	.	.	X	..	..	..
14.	"	<i>Youngi</i> , Garr.	.	.	.	X	..	..	..
15.	"	<i>planospira</i> , Garr.	.	.	.	X	..	..	..
16.	"	<i>unilamellata</i> , Garr.	.	.	.	X	..	..	..
17.	<i>Pitys</i>	<i>zebrina</i> , Garr.	.	.	.	X	..	..	..
18.	"	<i>multilamellata</i> , Garr.	.	.	.	X	..	..	..
19.	"	<i>imperforata</i> , Pease	.	.	.	..	X	..	..
20.	"	<i>rotellina</i> , Pease	.	.	.	..	X	..	..
21.	"	<i>Roratongensis</i> , Pease	.	.	.	..	..	X	..
22.	<i>Libera</i>	<i>fratercula</i> , Pease	.	.	.	X	X	X	X
23.	"	<i>cavernula</i> , Garr.	.	.	.	X	..	..	..
24.	"	<i>tumuloides</i> , Garr.	.	.	.	X	..	..	..
25.	"	<i>sp.</i>	.	.	.	..	X	..	..
26.	<i>Stenogyra</i>	<i>Tuckeri</i> , Pfr.	.	.	.	X	X	X	X

						Rarotonga.	Aitutaki.	Atiu.	Mangaia.
27.	<i>Partula assimilis</i> , Pease	.	.	.	.	X	..	..	..
28.	" <i>hyalina</i> , Brod.	.	.	.	.	..	..	..	X
29.	<i>Tornatellina Philippii</i> , Pfr.	.	.	.	.	..	X	..	..
30.	" <i>oblonga</i> , Pease	.	.	.	.	X	X	X	X
31.	" <i>perplexa</i> , Garr.	.	.	.	.	X	X	X	X
32.	" <i>simplex</i> , Pease	.	.	.	.	X	X	X	X
33.	" <i>serrata</i> , Pease	.	.	.	.	X	X	X	X
34.	" <i>nitida</i> , Pease	.	.	.	.	X	X	X	X
35.	" <i>conica</i> , Mouss.	.	.	.	.	X	X	X	X
36.	<i>Vertigo pediculus</i> , Shutt.	.	.	.	.	X	X	X	X
37.	" <i>tantilla</i> , Gould	.	.	.	.	..	X	..	..
38.	<i>Limax Rarotonganus</i> , Heyn.	.	.	.	.	X	..	..	..
39.	<i>Succinea costulata</i> , Pease	.	.	.	.	..	X	..	..
40.	<i>Melampus luteus</i> , Q. et G.	.	.	.	.	X	X	X	X
41.	" <i>fasciatus</i> , Desh.	.	.	.	.	X	X	X	X
42.	<i>Laimodonta conica</i> , Pease	.	.	.	.	X	..	..	..
43.	<i>Diadema parva</i> , Pease	.	.	.	.	..	X	..	..
44.	" <i>biangulata</i> , Pease	.	.	.	.	..	X	..	..
45.	" <i>rotella</i> , Pease	.	.	.	.	X	..	..	..
46.	<i>Omphalotropis ochrostoma</i> , Pease	.	.	.	.	..	X	..	..
47.	" <i>variabilis</i> , Pease	.	.	.	.	X	X	X	X
48.	" <i>ovata</i> , Pease	.	.	.	.	..	..	..	X
49.	<i>Scalinella affinis</i> , Pease	.	.	.	.	..	X	..	..
50.	" <i>scalariformis</i> , Pease	.	.	.	.	..	..	X	..
51.	<i>Helicina parvula</i> , Pease	.	.	.	.	X	X	X	X
52.	" <i>flavescens</i> , Pease	.	.	.	.	X	X	X	X
53.	<i>Chondrella striata</i> , Pease	.	.	.	.	X	X	X	X
54.	<i>Assimineia nitida</i> , Pease	.	.	.	.	X	X	X	X
Total species						39	28	20	19

When we take into consideration the small size of the islands, the largest (Rarotonga) not more than five or six miles in length, and the only one carefully explored, we are astonished at the number of species and profusion of individuals scattered over such small areas.

Excepting the two *Partula* and *Melampi*, all the species are of minute size.

Rarotonga, which is the largest and loftiest island, has so far yielded thirty-nine species, twenty-one of which are peculiar.

Aitutaki, which is only partly explored, has produced twenty-eight species, ten of which do not occur elsewhere.

Atiu has twenty species, two only of which are peculiar. All these species were collected in a very small area in a dense forest near the sea-shore.

Out of nineteen species found on Mangaia, one only is confined to that island. The *Partula*, which does not occur on the other islands of the group, is common to Tahiti and the Austral Islands. All the twelve species were collected in two small portions of the island.

As stated in the commencement of this article three of the islands are virgin ground to the shell-collector.

Of the fifty-four known species, thirty are peculiar to the group, and twenty-four are more or less widely diffused throughout the other Polynesian Islands.

The Placenta and Generative Apparatus of the Elephant.

BY HENRY C. CHAPMAN, M.D.

PLACENTA.

IN January, 1879, I was requested by the late Dr. F. F. Maury to visit the Indian elephant, Hebe, forming a part of the menagerie of Cooper & Bailey's London Show, then in winter quarters at Twenty-third and Ridge Avenue, in this city. The object of the visit was to determine, if possible, whether the elephant was pregnant. At my suggestion, Drs. Leidy, Penrose, and Hunt were invited to be present at the examination. The result of the investigation by these gentlemen confirmed me in the opinion that the elephant was indeed pregnant, rare as I knew such a phenomenon to be in a state of captivity. Indeed, it was questionable whether there had ever been such a case on record well authenticated. It is true that Prof. Owen states* that two elephants paired Dec. 18, 1863, and that a young one was born Aug. 3, 1865, but it is not stated where the birth took place, nor is any author cited in reference to it. Admitting this case, on the authority of such a distinguished naturalist, it will be the only one, as far as I know, recorded up to this date. On questioning the intelligent keeper of the elephant, Mr. George Arstingstall, I learned that on May 25, 1878, the female in question had received the male, and that coitus had taken place on the 29th of the same month, and on the 3d, 8th, 13th, 15th, and 20th day of June. The latter day was that on which the last copulation took place, there having been seven in all. As various views have been expressed by naturalists as to the manner of connection, I will content myself with stating what I have seen and learned from the above-mentioned eye-witness, that the coitus is similar to that of bull and cow, or horse and mare, and that the time occupied is about the same period as in the horse. The penis when erect is curved, the concavity looking forward. When relaxed, the organ is curved in the opposite direction. Eight months having elapsed since the last coitus, it was natural that there should be some signs of pregnancy if fecundation had really taken place. The shape of the abdomen and the prominence of the mammæ, which are pectoral in position and are usually not very apparent, together with the fact that connection had taken place several times, were about the only

* Anat. of Vert., vol. iii. p. 742.

facts I had for predicting the birth of the young elephant. Naturally, the question was at once asked, What is the period of gestation? Here again I was comparatively in the dark. In the *Thesaurus of Seba*, published in 1734,* there is figured the foetus of an elephant without any of the membranes, said to have been taken out of its mother at about the middle of the period of gestation. Zimmerman also gives a figure of a foetus.† In the description of this foetus only vague allusions are made to the length of gestation. As is well known, among the ancients, Pliny thought the period in the elephant was six months, Strabo about eighteen; according to Aristotle, however, nearly two years. What I had learned from travellers in the East, and from the case referred to by Prof. Owen, the time being in that instance 593 days, together with the fact of Aristotle‡ giving nearly two years, led me to indicate that about the 1st of March, 1880, would be the time at which the birth of the elephant might be looked for. The young elephant was born on March 9, 1880, at 2.30 A.M., exactly twenty months and twenty days after the last copulation, or twenty-one months and fifteen days reckoning from the first one, a longer period by thirty-seven or sixty-two days as compared with the case referred to by Prof. Owen. The fixing of the period of gestation 630 to 656 days in the elephant is another interesting illustration of modern investigation confirming the statements made by that most profound thinker and careful observer, Aristotle.

The labor was a very short one, the mother standing on all fours, with one hind foot slightly raised. The head presented, as observed by Mr. Porter. The umbilical cord broke, and was removed with the placenta and membranes shortly afterward by Mr. Arstingstall. Immediately after birth the mother rolled the young one in the straw. The young elephant, a female, stood 30 inches in height; measured, from base of trunk to root of tail, 35 inches; and weighed $213\frac{1}{2}$ pounds. It was perfectly formed and well developed. It was noticed immediately that it sucked with the mouth, and not with the trunk, as Buffon reasoned it must do—an error so often repeated in works on Natural History. The young elephant spends most of its time sleeping, sucking, and walking about. The mother is extremely watchful, and restrains, by means of its trunk, the young one from getting out of its reach. When first consulted in reference to the supposed pregnancy, I impressed Mr. Arstingstall, who was then in charge, with the importance, if an elephant were born, of preserving any membranes that might come away during labor. I am indebted to his kindly interest, and to the liberality of

* Fig. 111.

† Besch. eines Ungeborenen Elephanten, Erlangen, 1783.

‡ De Generat. Animalium. Liber quartus, cap. 8.

Messrs. Cooper & Bailey, for placing the specimen at my disposal, and for affording me the opportunity of showing it to the members of the Academy. As far as I know, it is the only placenta in existence of an elephant delivered at full term. Prof. Owen received from Dr. Martin, of Ceylon, the placenta and membranes of an elephant supposed to have been born about the middle of gestation. This specimen was sent from India to London in arrack, and was described by Prof. Owen in 1857. It has been preserved since then in spirits, in the Royal College of Surgeons, in London, and was re-examined by Prof. Turner, of Edinburgh, the result of his investigation being given in his Lectures on the Comparative Anatomy of the Placenta.* As will be seen from the following description, my specimen differs from that of Prof. Owen, but I think this difference is due, as might be expected, to the fact that one was delivered at full term, the other at only half that period.

As is well known, in certain animals, like the pig, cow, sheep, horse, etc., the chorion, or membrane which incloses the foetus, comes away in labor without bringing with it any of the mucous membrane lining the uterus of the mother; hence, this kind of placenta is said to be noncaducous, nondeciduous, or noncoherent. The placenta in these animals is also said to be diffuse, as in the pig; or cotyledonary, as in the cow—according as the villous processes are diffused over the outer surface of the chorion, or are limited in the form of knots, bunches, or cotyledons. In man, monkeys, rats, bats, dogs, etc., during parturition, there is always cast off a greater or smaller portion of the mucous membrane of the mother; and the villous processes of the chorion of the foetus insinuate themselves to such an extent into the mucous membrane of the uterus that the placenta in these animals consists of a foetal and a maternal part; whereas, in the non-deciduous mammals the placenta consists simply of foetal membranes. Hence, in man and the other animals last mentioned, the placenta is called coherent, or deciduous, or caducous. But just as the nondeciduous placenta exhibits itself under two forms, so we find the deciduous placenta either disk-shaped or zonular. The first kind is seen in the placenta of man, monkeys, etc.; the second in that of the dog and carnivora generally. Under what form of placenta does that of the elephant come? Without doubt the zonular, and to a certain extent, also, the diffuse, as Prof. Owen has asserted. Is it a deciduous or nondeciduous placenta? Prof. Turner has satisfied himself, from an examination of Prof. Owen's specimen, that it is deciduous.† The examination of the injected bloodvessels‡ in my speci-

* Comp. Anat. Placenta. Edinburgh, 1876.

† Op. cit., p. 101.

‡ Mr. Nash was good enough to inject the specimen for me, with perfect success. Otherwise it would have been difficult to distinguish the foetal and maternal parts, so interlaced were they.

men leaves little doubt that at least one-fourth of the girdle-like placenta of the elephant consists of the hypertrophical mucous membranes of the uterus. It will be seen, therefore, that the placenta of the elephant is not only interesting on account of its rarity, but also from its combining the characters of the placenta of three different sets of animals. The impossibility of using the placenta, in the case of the elephant at least, as a means of classification is therefore sufficiently obvious. As the taxonomic value of the placenta in general has been well discussed by Home, Owen, Milne Edwards, Huxley, and others, I will not dwell further on that part of the subject, but proceed to describe the specimen before me.

The chorion (Pl. 48, *a, a'*) of the elephant is an oblong whitish sac tapering rather into an obtuse end. Its length is five feet two and a half inches, width two feet four inches. The outer surface of the chorion is tolerably smooth and transparent. The inner surface exhibits a number of bloodvessels. The chorion is encircled or girdled by the placenta (Pl. 48, *c*). On each side of the placenta there is an indistinct brownish granular layer (Pl. 48, *x*) four inches in width and about a line thick, which runs parallel with the whole circumference of the placenta, and in some places even overlaps it slightly. This same granular matter was found even scattered over the surface of the placenta, and was easily rubbed off with the finger. Its microscopic structure reminded me of broken-down granular matter, and I suspect it may be maternal in its origin. At the two poles of the chorion I found the "subcircular vascular villous patches" (Pl. 48, *v*) described by Prof. Owen. The villi in this position were not more than a line long. The placenta entirely surrounds the chorion, but is situated at one side of the middle line. Consequently, the two parts of the chorion differ in length, the longer measuring thirty-five inches, the shorter twenty inches. The width of the placenta is seven and a half inches, making a total length in long diameter for the chorion of sixty-two and a half inches, as stated above. The circumference of the placenta is five feet one inch, and on an average it is two inches thick. The placenta preserves the same average width all round; there is no constriction dividing it into the "two moities" described by Prof. Owen; and another difference is that the villous processes are as well developed at the edges of the placenta as in the middle. Indeed, there is no smooth surface whatever, as seen in Prof. Owen's specimen. The general appearance of the placenta was that of a brownish spongy zone. After injection, however, when the vessels had been filled, the red color differentiated very well the foetal from the maternal parts, which were closely interlaced. The villi divided and subdivided in an arborescent manner,

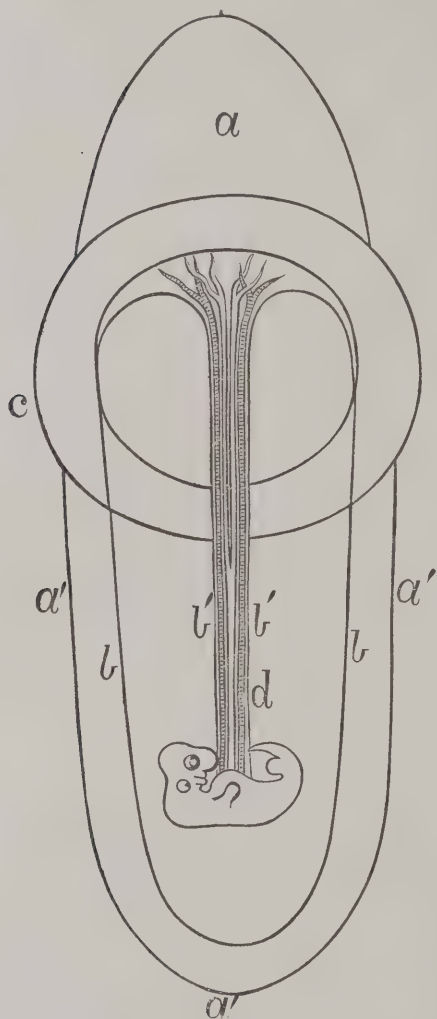
and were coarse in structure. Some passed through the whole depth of the placenta; others a half and third of that length. The terminal branches of the vessel could be readily followed in them, dividing and subdividing in the same manner, and ending in loops. It will be seen, therefore, that the chorion is principally attached to the uterus by means of the girdle-like placenta, but probably to a small extent also by the villous patches, seen at each pole. These patches have a greater morphological than physiological significance. In my specimen the end of the smaller sac of the chorion (Pl. 48, *a'*) is open, with the broken umbilical cord, *d*, protruding, evidently owing to the young elephant having ruptured it at birth. The amnion (Pl. 48, *b, b*) necessarily is also broken at one end, for the same reason. A considerable portion of this membrane (Pl. 48, *b', b'*) remains attached to the umbilical cord and to the foetal surface of the placenta, and is reflected on each side to the foetal surface of the chorion for two inches, and then hangs free from the chorion to an extent of twelve inches. The rest of the amnion, several feet, was preserved separately. If I have described these parts correctly, it follows that when the foetus is in utero, and the membranes intact, there must be a space between the amnion and the chorion in which the allantois and umbilical vesicle will be found. To these structures I will return in a moment.

The inner surface of the amnion is studded over with whitish hemispherical bodies about one line in diameter. Prof. Owen describes the color as brownish; the difference may be due to the spirit in which his specimen was preserved. Under the microscope* these granules appeared to consist of fibres with small bodies interspersed. In the paper already referred to, Prof. Owen describes the mucous or unvascular part of the allantois as consisting of three sacs, and disposition of these sacs in reference to the chorion and amnion. Without questioning the correctness of the description of his specimen in this respect, it does not apply to mine, there being no evidence here of any allantois as a distinct sac. This is not surprising, however, when one considers the very great difference that the allantois exhibits in animals, as regards size, permanency, etc. Indeed, the size of the allantois varies to such an extent that Prof. Milne Edwards gives a classification based upon this difference, calling the divisions Megallantoids, Mesallantoids, and Microallantoids respectively. The allantois may remain as a simple sac so undeveloped as never to fuse with the chorion, as I have recently seen it in a foetal kangaroo in utero;† or, after having fused with or replaced the chorion, it may

* I am indebted to Dr. Morris Longstreth for kindly examining some of the structures, and for confirming what I learned from my own observation.

† The first instance of this kind was described by Prof. Owen.

entirely disappear as a distinct sac, as in man. Between these extremes there are a number of intermediate stages exhibited in mammals. Remembering, then, that the permanency of the allantois as a distinct sac is very variable, but admitting that at some period of gestation it is present in the elephant, it is incumbent upon me to endeavor to explain what became of it in my specimen. As is well known,



a. Chorion, large pouch. *a'.* Chorion, small pouch. *b, b'.* Amnion. *d.* Umbilical cord. *c.* Placenta.

the allantois is a diverticulum of the posterior part of the alimentary canal, and as this canal is developed out of the hypoblast and part of the mesoblast, necessarily the allantois will consist of the same two layers, or darmdrusenblatt and darmfaserblatt of the German embryologists. The allantois expands into the amnio-chorionic space, and gradually reaches the chorion. Its outer layer, the mesoblastic part, the darmfaserblatt, or the vascular or exochorionic portion, replaces or fuses with the chorion, and is the layer in which the foetal vessels are found. It is this layer which forms the foetal portion of the placenta in my specimen. The inner layer of the allantoic sac, which is a continuation of the epithelial layer of the alimentary canal, the hypoblastic part, the darmdrusenblatt, the mucous or endochorionic layer, is, however, non-vascular. Now suppose that the outer part of this layer adheres to the vascular layer as the vascular layer adheres to the chorion, and the three membranes fuse their identity into one. All trace, then, of the mucous unvascular endochorionic part of the allantois will have disappeared as a distinct membrane, as is the case in the human being. On the other hand, if the inner part of the mucous and vascular layers,

which lie against the amnion, should fuse with it, then that part of the mucous layer of the allantois would also disappear in the course of development. Such a mode of disappearance of the allantois seems to have taken place in the development of the membrane of my specimen. For, on carefully examining the amnion, I find that in a greater part of its extent it can be separated into two layers, the

outer of which seems to represent part of the allantois. On the other hand, while it is impossible to distinguish the chorionic layers, nevertheless it will be seen that the branches of the umbilical arteries and veins lie upon the inner or foetal surface of the chorion, and that they pass over the chorionic surface of the cotyledons. Now, Prof. Owen states that in his specimen these cotyledons (Pl. 49, *z, z, z*) adhered to the "allantoic side of the sheath of the vessel," and that "the cotyledons belonged entirely to the latter membrane;" that is, the allantois, after this had been removed from the chorion. This confirms what an examination of my specimen led me to suppose, namely, that the vessels and cotyledons lie between two layers: the outer one, the chorion and vascular-layer of the allantois; the inner, the mucous layer of the allantois—all three being fused into one in my specimen. If this view be correct, the elephant in utero would be inclosed, first by the amnion—then there would be a space; and, secondly and externally, by the chorion. The allantois would exist only as a distinct sac in the earlier periods of pregnancy. The same will hold true of the umbilical vesicle, of which I did not find a trace. Prof. Owen tells us that he counted one hundred and twenty cotyledons in his specimens. There are over two hundred and fifty in mine, varying from half an inch to over an inch in length.* I noticed about a dozen in the amnion, which also confirms the view offered of its having two layers. These bodies seem to be fibrous in structure, with some inter-fibrous granular matters. As to their morphological or physiological import I have nothing to offer.

The umbilical cord is three inches in diameter and fifteen inches in length, measured from beginning of umbilical vein to where it divides into two branches (Pl. 48, *d*). It consists of two arteries and one large vein, held together by the usual connecting tissue (Pl. 48, *d*). The main vein divides into two, which attain a length of about twenty-two inches before reaching the outer border of the placenta (Pl. 49, *d, d'''*). The outside artery, double the size of the innermost one, divides into two branches, which accompany the branches of the vein to the outside of the placenta (Pl. 49, *d, d'''*). The umbilical vein, ten inches above its bifurcation, gives off a slender branch (Pl. 49, *d', d''*), which bifurcates six inches below its origin, and passes to the middle parts of the placenta. The small umbilical artery divides into two branches, which accompany the small umbilical veins to middle of placenta (Pl. 49, *d', d''*). There are, therefore, two large and two small main arteries, and two large and two small main veins. The manner in which these vessels are situated in the placenta is sufficiently apparent from the figures.

* I find them usually in the vicinity of the placenta and along the course of the longest vessel.

GENERATIVE APPARATUS.

The female generative apparatus of the Indian elephant is described by Hunter,* Mayer,† and Miall and Greenwood.‡ That of the African elephant by Perrault§ and Forbes.|| Having had the opportunity of examining the generative apparatus of the African elephant, which died at the Philadelphia Zoological Garden last July, and being at that time unacquainted with Mr. Forbes' description, which was read to the London Zoological Society, April 23d, I took several measurements on the spot, and having preserved the specimen in spirits, it occurred to me that it would be interesting to supplement the description of the placenta with that of the generative organs. It is true that the placenta is of one species and the organs of another; but the difference in the sexual organs of the Indian and African elephants is so slight that the description of the one serves very well for that of the other. I state this not only from the observations of the anatomists cited above, but from an examination I made in August, 1874, of an Indian elephant known to be over one hundred years old, which also died at the Zoological Garden. The alimentary apparatus was shown at one of the meetings of the Academy, and described. The cause of death in that case was cancer of the uterus and urogenital canal; and disease had so obscured the parts that I did not venture to interpret them at that time. On comparing the structures with the healthy ones of the African elephant I am satisfied that they agreed in all essential respects.

In the African elephant, which was about half grown, I found the vulva situated two feet anteriorly from the anus. It led into a passage that I believe should be called the urogenital canal, inasmuch as it serves to transmit the generative products and the urine (Pl. 50, *i*). This canal measured 36 inches in length and 28 inches in circumference, and was lined with a mucous membrane exhibiting rugæ. Just within the vulva the glans of the clitoris was quite apparent with its prepuce (Pl. 50, *m*). The clitoris measured 15 inches. The crura are attached to the rami of the pubis¶ (Pl. 50, *l*). At the upper end of the urogenital canal may be seen together three openings, the middle one large enough to admit only one's finger (Pl. 50, *g*), leading into what seems to be homologous with the vagina;

* Essays, edited by Prof. Owen. London, 1861.

† Nova Acta, vol. 22, 1847.

‡ Journal of Anatomy and Physiology, 1879, vol. 13.

§ Mem. de l'Acad. des Sciences, tom. iii., 1734.

|| Proceedings of Zoological Society, 1879.

¶ I noticed also the muscles corresponding to the levatores penis in the male.

the two smaller ones on either side of the vaginal opening are the sinuses of Malpighi. These three openings can be completely shut off from the urogenital canal by a valvular fold of mucous membrane, of a somewhat semilunar shape, about $2\frac{1}{2}$ inches in breadth (Pl. 50, *h*). The effect of this fold seems to be to prevent the flow of the urine into the vagina; as the urogenital canal *in situ* is so situated that this would be apt to take place, the canal being curved and the posterior part of the curve being lower than the anterior. Below this valvular fold is seen the opening of the bladder into the urogenital canal. The circumference of the bladder measures 18 inches. The vagina, the cavity into which the urogenital canal opens, is 14 inches in length, and 6 inches in circumference (Pl. 50, *f*). The mucous membrane is lined with longitudinal folds. The vagina opens into a cavity which seems to be the uterus* (Pl. 50, *d*). The uterus can be entirely occluded from the vagina by a fold of mucous membrane. This fold (Pl. 50, *e*), which is vaginal, measures about $1\frac{1}{2}$ inch, and is of semilunar form, but indented in the middle. The opening of the vagina into the uterus is about twice as large as that of the vagina into the urogenital canal. The length of the uterus was 7 inches; its diameter, 5 inches. Its mucous membrane, thrown into longitudinal plaited folds, was similar to that lining the cornua. The two cornua opened by distinct passages into the body of the uterus, and were 30 inches in length, and measured nearly three inches in circumference (Pl. 50, *c*). The Fallopian tubes—passing rather into the side of the cornua, about two inches in length, and with a diameter of about one-eighth of an inch—expanded into the trumpet-shaped fimbriated extremity (Pl. 50, fig. 2). The fringes of the pavilion were long, slender, and tassel-like. The peritoneal fold supporting and surrounding the pavilion was also fringed. There is a distinct fold of peritoneum separating the pavilion from the ovary (Pl. 50, fig. 2). The ovary and pavilion can be entirely inclosed by the pouch of peritoneum attached to them (*p*). The right ovary, in largest diameter, measured $2\frac{1}{2}$ inches; the left, 2 inches. On cutting into the ovary, I did not find very many Graafian follicles. I found, however, the ovum in one of them, which, under the ordinary powers of the microscope, did not exhibit any character different from that of the mammalia generally, the zona pellucida, germinal vesicle and spot being all identified. It will be noticed, on referring to Miall, Greenwood, and Owen, that their description of the Indian elephant is essentially the same as that of the African species I have just given. According to Mayer, however, in the Indian, and to Perrault in the African species,

* What I have called vagina may really be an elongated cervix uteri.

there is no distinction between what I have called uterus and vagina, there being but a single chamber between the cornua and what I have called the urogenital sinus, which Mayer* considers vagina, "Die mit der urethra vereigte vagina". I have mentioned only incidentally up to this time Mr. Forbes's valuable paper, as I preferred giving my description as I noted the structures in last July. Of course his paper has priority; but it is a satisfaction to me that I came independently to the same conclusions as Mr. Forbes without a knowledge of his dissections.

It appears to me that there can be little doubt now that the generative organs in both species of elephants are understood. It is true that at first sight the uterus appears to be a small chamber to hold a baby elephant; yet, when the size of a human baby is considered in reference to the womb holding it, the ratio will be seen to be rather in favor of the elephant. It would certainly be inferred, from the size of the urogenital sinus, that the labor would be easier in the elephantine than in the human female, as was seen to be the case. Nevertheless, it would be a satisfaction to see an elephant in utero, with the membranes intact, so that the morphology and physiology of the parts might be determined beyond cavil by a philosophical physiologist. For, inasmuch as the uterus and vagina are formed through the coalescence of the Müllerian ducts, it is impossible *a priori* to say how much of the duct would become uterus and how much vagina.

* Op. cit., p. 38.

EXPLANATION OF PLATES.

PLATE XLVIII. PLACENTA AND MEMBRANES.

Fig. 1. *a.* Chorion, large pouch. *a'.* Chorion, small pouch. *c.* Placenta. *d.* Umbilical cord. *v.* Sub-circular vascular villous patches. *x.* Brownish granular layer.

Fig. 2. *a.* Chorion, large pouch. *a'.* Chorion, small pouch under surface. *b, b'.* Amnion. *d.* Umbilical cord. *c.* Placenta.

PLATE XLIX. PLACENTA.

d, d', d'', d'''. Arteries and veins of umbilical cord—distributed through membrane and bearing cotyledons, *z.*

PLATE L. GENERATIVE APPARATUS. SEEN FROM BEHIND, POSTERIOR WALL SLIT UP IN MEDIAN LINE.

Fig. 1. *a.* Ovary. *b.* Fallopian tube. *c.* Cornua uteri. *d.* Corpus uteri. *e.* Valve. *f.* Vagina. *g.* Aperture and sinuses of Malpighi situated in partition between vagina and urogenital canal. *h.* Valve protecting vaginal opening. *i.* Urogenital canal. *k.* Bladder. *l.* Clitoris seen through anterior wall of urogenital canal. *m.* Glans clitorides.

Fig. 2. *a.* Ovary. *b.* Fallopian tube with penetrated extremity. *p.* Edge of fold of peritoneum separating ovary from penetrated extremity.

The Parasites of the Termites.

PLATES 51, 52.

By JOSEPH LEIDY, M.D.

IN common with many other observers, the writer has always felt an interest in the history of Ants, including also those insects of another order, the Termites or White-ants. A species of the latter, the *Termes flavipes*, belonging to this country, occurs abundantly in the dry sandy forests and fields of southern New Jersey; in some places being found beneath almost every piece of decaying timber and in every old stump. It is frequent beneath discarded railroad ties as they lie decaying at the sides of the road, but I have heard of no complaint of the insect attacking the sound ties in use, nor indeed the sound timbers of any kind in the neighboring fences and buildings. In the vicinity of Philadelphia, the Termites, though less frequent and abundant than in New Jersey, are yet common enough, and are often to be found beneath stones as well as in old rotting timbers.

The passage-ways of the insects, beneath stones, and the galleries they hollow in wood, are plastered with a brownish material apparently consisting of their own excrements.

In watching the Termites from time to time wandering along their passages beneath stones, I have often wondered as to what might be the exact nature of their food in these situations. Observing some brownish matter within the translucent abdomen of the insects, I was led to examine it with the object of ascertaining its character. On removing the intestinal canal of an individual I observed the brownish matter was contained within the small intestine, which is comparatively large and capacious. The brownish matter proved to be the semi-liquid food; but my astonishment was great to find it swarming with myriads of parasites, which indeed actually predominated over the real food in quantity. Repeated examination showed that all individuals harbored the same world of parasites wonderful in number, variety, and form.

Wishing to learn something more of the extraordinary parasitic community of the Termites thus accidentally discovered, I was led to refer to the literature concerning these insects; but I found no description of the parasites. The only authority I met who appears to have noticed them is M. Ch. Lespes in an excellent

"Memoir on the Organization of *Termes lucifugum* of France," published in the *Annales d. Sciences Naturelles*, vol. v., 1856. Page 237, in describing the digestive apparatus of the workers, he says: "Au ventricule fait suite une poche volumineuse, courbe, boursouflée, et pleine d'une matière brune dans laquelle fourmillent les nombreux Infusoires dont j'aurai à m'occuper plus tard. D'après la nomenclature généralement adoptée ce devrait être l'intestin grêle." Further, on the same page, he says: "L'intestin est ordinairement rempli d'une sorte de bouillie brune, vivante agglomération d'Infusoires."

Page 258, M. Lespés remarks in regard to the winged males and females, "le tube digestive contient rarement la bouillie brune que nous avons trouvée chez les ouvriers et les soldats; c'est une matière de couleur beaucoup moins foncée que le remplit. Il fourmille toujours d'animalcules que je d'écrirai plus tard." At the conclusion of an article entitled "Note on a Nematoid Parasite of the Termites," page 335 of the same volume, M. Lespés says: "J'ai trouvé dans le tube digestive des Termites un assez grand nombre de parasites, sur lesquels je me promets de revenir avant long temps."

A quarter of a century has elapsed and yet it would appear that M. Lespés has given no further account of the parasites of the Termites, which may be regretted, for we have reason to believe that the author of the memoir on the organization of the *Termes lucifugum* would have given us an equally faithful account of the community of creatures it sustains.

Some animals are so habitually and constantly infested with multitudes of various parasites that it would appear to be their normal condition. Such is strikingly the case with our common large *Julus J. marginatus* or *Spirobolus marginatus*, and the still more common beetle, *Passalus cornutus*, as described by the writer in an article entitled "A Flora and Fauna within Living Animals," published in 1853, in the *Smithsonian Contributions to Knowledge*. So constant is the occurrence of parasites in the animals just indicated, that in reference to one of them I was led to remark that entophytes would be constantly found in the genus *Julus* in any part of the world (*Proc. Acad. Nat. Sci.* 1849, 228). It was perhaps this expression of opinion which led M. Charles Robin to examine the *Julus terrestris* of Europe, leading to the discovery of the *Enterobryus Juli terrestris*. (See *Hist. Nat. des Vegetaux Parasites*, etc., Paris, 1853, p. 398.) Only a few weeks since while strolling in the country I noticed a *Julus* crossing the road, when it occurred to me that it would afford me an opportunity of comparing one of its parasitic plants with one occurring in the Termite, and I therefore took possession of the truant. On examination, sure enough, there were all the para-

sites which I had observed in many individuals of the same, thirty years ago—three distinct species of nematoid worms, the infusorian *Nyctotherus*, the beautiful entophyte *Enterobryus elegans*, *Arthromitus cristatus*, etc.

Our White-ant, *Termes flavipes*, belongs to the same hospitable company of victuallers as the Wood-Julus, *Spirobolus marginatus*, and the Unicorn Wood-beetle, *Passalus cornutus*, and as constantly sustains a multitude of parasites, both animal and vegetable. It is a remarkable fact that the three creatures just named; a neuropterous insect, a beetle, and a myriapod, use the same food and even at times occupy the same habitation—an old stump, or decaying log. Viewing the immense communities they protect and feed, they would in a measure appear to be of subordinate importance, and may be regarded as powerful mills which reduce the ligneous food to a pulpy condition, adapted to the more delicate constitution of their occupants.

It may be inferred that other species of the same genera above mentioned, with similar habits, will be found equally infested with swarms of parasites. What an idea this gives one of the immensity of life when we reflect upon the probable fact that each and every individual of the already innumerable Termites of the tropics are equally peopled with our own! No wonder, considering the communities they have to feed, that they should be so great a pest to man, even to eating his house, furniture, and books! Here also is a new world to be explored; what a treat it would be to see the nations which inhabit the *Termes fatalis* and other species of western Africa, and those of Ceylon, India, and of South America!

When the intestine of the Termite, *Termes flavipes* is withdrawn from the abdomen and submitted to gentle pressure, under the microscope, the brownish matter in the interior is observed as a swarming mass, in which the largest of the parasites, mainly comprising the latter, are distinguished pushing their way through the crowd. If the intestine is ruptured, myriads of the living occupants escape, reminding one of the turning out of a multitude of persons from the door of a crowded meeting-house. So numerous are the parasites and so varied their form, movement, and activity, that their distinctive characters cannot be seen until they become more or less widely diffused and separated.

By far the greater proportion of the brownish pulpy contents of the small intestine of the Termite consists of parasites, and indeed the first impression might be that these were the actual food, while the small proportion of smaller and indefinite particles were accidental elements swallowed with the animalcules. To be sure these are at first all living and do not exhibit the usual appearance of

swallowed living prey; that is to say, all or nearly all dead and in different stages of digestion. Nevertheless, the proportion of materials which I had inferred to be the ordinary food of the Termite was so very small in comparison with the immense numbers of associated and incessantly present parasites, that I could not avoid the suspicion that these might possibly be collected from among the decaying wood in and on which the Termites were considered to live. An examination, however, of the wood in which the Termites lived, and of the plastering of their galleries, exhibited no traces of the parasites or of spores or eggs which could be referred to the latter.

Of the parasites of our Termite there appear to be three or four, or perhaps more distinct species of remarkable protozoans, but of this I am not positive, for I have suspected that several which I at first viewed as such may be only different stages of the same. On the other hand, certain forms which I have regarded as younger stages of species as I have distinguished them, may in future investigation prove to be equally distinct. These parasites are widely different from any previously described of which I have any knowledge, and they have exceedingly puzzled me as to their nearest relations. Their delicacy of structure, rapid movements and variation in shape, and liability to change from more or less rapid decomposition, render their characters intricate and difficult to unravel. In the following descriptions I have of course attempted to represent them as they have appeared to me from time to time, but I am not altogether satisfied with the results, and apprehend that in some cases I have not interpreted the appearances correctly. With the peculiar parasites indicated there are several others which are of a vegetal character, and these likewise are described in the following pages.

Our Termite also is infested with a nematoid worm in an immature condition, the *Isacis migrans*, discovered by M. Lespés, in the same state, in the *Termes lucifugum* of France, and likewise found by him in the mature condition in the earth of the nest of the Termite. Further, a gregarine, so common in insects, is also occasionally found in our Termite.

Termites, or White-ants, are so common, easily obtained and preserved alive, and their parasites are so exceedingly numerous, constant in their occurrence, and curious, that once the fact becomes sufficiently known, the insects will become favorite subjects to illustrate at once the infinity of life and the wonders that are revealed by the microscope. The parasites were first observed by the writer in 1877, and a brief notice of them was published in the Proceedings of this Academy for the same year.

TRICHONYMPHA.

trix, hair; nympa, nymph.

TRICHONYMPHA AGILIS. Plate 51.

Proceedings of the Academy of Natural Sciences, 1877, p. 147.

The most conspicuous and extraordinary of the parasites of our Termite is one to which I have given the above name. It is with some regret that I am obliged to confess that notwithstanding all my scrutiny I have been unable to determine the characters of this singular creature sufficiently to learn whether to regard it as a ciliate infusorian, a gregarine, or a rhabdocoelus turbellarian. I am, however, disposed to view it as the former, or rather as of intermediate character to the two former.

Commonly in the extended condition *Trichonympha* is about $\frac{1}{30}$ th of an inch long, and about half the breadth of the length. In shape it resembles a gregarine; and it is clothed with cils of extraordinary length. (See Figs. 1-10.) When it first escapes from the intestine and is diffused on the object glass of the microscope it usually appears more or less distorted, and may be contracted to such a degree that the breadth exceeds the length, as represented in Figs. 1-3. By reflected light it appears white, and it is translucent.

Trichonympha presents a slight constriction at or a little in advance of the middle, so as to appear to consist of two portions, which with the general form give it very much the appearance of a gregarine. For convenience of description the two parts may be distinguished as head and body. (See Figs. 5-10.)

The head is conical, and usually appears shorter than the body, but is variable in this respect, depending on the degree of extension of the latter and the contraction of the former, or its depression within the body. Its apex is more or less produced as a mammillary eminence, which seems to be the chief if not the sole source of origin of the extraordinary long cils that extend backward and invest the animal as with a cloak.

The body is broader or more robust than the head, and of variable proportionate length, according as it is shortened by contraction or elongated by extension. It is conical, oval, cordiform, or more or less abruptly tapering according to the changes it undergoes in movement. The posterior extremity is obtusely rounded, or may become more or less subacute, or it may appear abruptly truncated. (See Figs. 1-10.)

In the fresh and most active condition of *Trichonympha* during its movements the head and body frequently vary in their relative proportions according to the degree of their contraction, shortening, and elongating. The head alternately

becomes somewhat elongated and narrower, and its summit more protuberant, and by contraction becomes in a corresponding degree shortened, widened, and more blunt. Often also the head turns backward, then forward. The body elongates and becomes narrowed, regularly tapering, and more or less pointed, rounded, or abruptly truncated; or it contracts and becomes shorter and oval, or abruptly bulges where it joins the head, and narrows abruptly towards the extremity; and sometimes it makes a half twist, or swells on one side and becomes depressed on the other. Frequently the head and body shorten and widen together, and the former sinks more or less deeply into the latter, as represented in Figs. 1 to 3.

Viewed on end *Trichonympha* appears circular, as seen in Fig. 4, inclosing a pair of inner circles produced by the outline of the head and a nucleus within.

The interior of *Trichonympha* is occupied by a mass nearly conforming in shape with the exterior, and like this consists of two corresponding portions. These would appear to relate to the two portions of the granular endosarc in a gregarine; and they have reminded me, at least in relative position and volume, with the capacious pharynx and stomach of a turbellarian worm.

As for convenience I have considered the two parts of the animal as head and body, for the same reason I shall speak of the outer and inner structures as ectosarc and endosarc, without regarding them actually as such in relation with an infusorian or other protozoan.

The anterior division of the endosarc occupies about three-fourths of the capacity of the head, appearing to be inclosed in a thick wall of ectosarc. It would seem to be conical, with the apex acuminate and the base abruptly terminating in the body endosarc on the line of conjunction of the head and body of the animal, as seen in Figs. 5-7, 9, 10. More closely examined, the head endosarc would appear to be ovoid, with the posterior broader extremity received into a depression of the body endosarc, as represented in Figs. 1-3, 8. The anterior acuminate end is extended to a point at the summit of the head.

The head endosarc is homogeneous, or very minutely and uniformly granular throughout. Its structure appears consistent and not fluent, or even semifluent as in the endosarc of gregarines and infusorians, but it presents no trace of striation or fibrillation to distinguish it as probably being of muscular nature. It is, however, elastic, and elongates and contracts in correspondence with movements of the head.

The body endosarc occupies a greater proportion of the interior capacity of the body than that of the head, but is less well defined from the inclosing ectosarc, especially at the posterior part, where it often appears insensibly to gradate

into the more homogeneous and transparent structure of the ectosarc. It is comparatively more distinctly and coarsely granular than the head endosarc, and is of much less uniformity. Its finer granular basis is mingled with larger granules of variable definition. It is also usually mixed with variable proportions of irregular, more darkly defined, and often angular particles, which appear to be fragments of solid food, bits of wood tissue, derived from the food materials of the host of *Trichonympha*. The supposed food particles are mostly directly mingled with the granular matter composing the mass of the body endosarc, and were rarely and but indistinctly observed to be included in globules of clearer matter, as is commonly the case in most protozoans which swallow solid food. In the movements and changes of shape of *Trichonympha* I never distinctly observed a freely fluent condition of the contents of the body endosarc, such as occurs in the rhizopods and other protozoans.

If the irregular particles so commonly observed in the body endosarc of *Trichonympha* are really solid food particles, I have been sorely puzzled and have failed to ascertain how they obtained entrance into the body. I have watched myriads of individuals hours together, without ever having seen one of them swallow or discharge a particle of food. I have been unable to detect anything like a mouth; and the ectosarc, unlike that of the rhizopods, has rather the unyielding character of that of *Gregarina*. I could detect no trace of a passage through the head endosarc, nor ever saw a particle within it which might be on its way to the body endosarc.

Occasionally I have observed among the more ordinary constituents of the body endosarc one or several clear globules or vacuoles. Though these have been obscurely seen to slowly enlarge and also to disappear, yet they did not present anything like the rhythmical movements of the contractile vesicle, so commonly an element of the protozoans.

In a few instances, in some individuals, I have further observed in the endosarc one or two large, coarsely granular spheres, as represented in Fig. 7. I have not been able to ascertain their nature, but have suspected that they are masses of ova-like bodies or spores.

The integument or ectosarc of *Trichonympha* appears to be homogeneous, and is transparent and elastic. It is also contractile, like that of *Gregarina*, but is in no wise extensible like that of rhizopods. Upon the head it is thicker than upon the body, and is more distinctly defined from the corresponding portion of the endosarc. It has appeared to me to present a delicate and regularly longitudinally striated condition, such as I have pointed out in the integument of *Grega-*

rina, and as represented in Figs. 5, 7, 9. I have, however, not been able positively to satisfy myself that this striated condition actually pertains to the ectosarc of *Trichonympha*, and have suspected that the appearance was an illusion produced by the long cils which invest the animal.

A large spherical nucleus is constantly to be observed in *Trichonympha* situated centrally at the conjunction of the two divisions of the endosarc, as seen in Figs. 1-10. It always maintains this position in all the movements of the animal. It has usually appeared to me to be imbedded within the fundus of the head endosarc, as seen in Fig. 8, though sometimes I felt in doubt whether this was actually the case. It is more or less distinctly and uniformly granular.

Commonly the nucleus of *Trichonympha* appears surrounded by a light ring or halo, but occasionally it is to be seen inclosed within a second and considerably larger and faintly granular sphere, as represented in Figs. 9, 10. No other definite structural elements than those above described were observed in the interior of *Trichonympha*, no appearance of reproductive elements, nor any trace of vessels.

The most remarkable character of *Trichonympha* is its wonderful cloak of vibrating cils. No other animal of which I have any information has the appendages of such great length. They appear to emanate altogether from the summit of the head, and spread outward and backward enveloping the animal, and extending a considerable distance beyond its posterior extremity. They originate in several series, or circles in succession, three or four as it seems to me, as represented in Figs. 1-3, 5, 7, 9, 10.

The first series of cils start immediately back of the pointed summit of the head, and are the shortest. They extend upon the sides of the head and incessantly wave outwardly.

The second series of cils proceed from a circle immediately behind the former, and extend outward and backward to the fore part of the body. These wave outwardly like those of the first rank of cils.

The third series, starting from the head beneath the former, spread downward and inward or outward over the body to its posterior extremity, or beyond it to an extent proportionate with the shortening of the animal. The second rank of cils gently and incessantly vibrate, and are continually lifted and depressed or open and close. The motion occurs regularly and uniformly all around, or it may occur to a variable degree partially, and more actively in one direction than in another. The motion reminded me of the gentle streaming of a delicate sheet of water from the edge of a fountain vase, and if displayed more on one side than another it resembled the same sheet swayed by the wind.

When *Trichonympha* curls its head into a helix, the three ranks of cils above described, appear to diverge in vortices from the inflection of the head, as I have attempted to represent in Figs. 6, 8.

The fourth rank of cils, the longest of all the series, springing from the head, fold backward in a spiral direction, closely envelop the body, and extend beyond its extremity in a twisted fasciculus with divergent ends. (See Figs. 1-3, 5-10.) These cils ordinarily appear to be motionless, but sometimes show a disposition to untwist and open outwardly. Usually they extend back of the body much farther than the third rank of cils, but in the varied movements of the animal in extreme shortening the latter may reach even beyond the former, as seen in Figs. 3, 8.

When *Trichonympha* is viewed on end, so as to appear circular in outline, its long cils diverge more or less uniformly all round in a tangential manner, and recall to mind a similar view of the peristome of a vorticella. At times in the same view the cils appear to diverge in several groups, and converge towards the ends, as represented in Fig. 4.

In its natural position *Trichonympha* may be detected amidst the dense concourse of its associates gliding through and displacing them as it advances. As usually observed upon the object glass of the microscope it remains nearly or quite stationary in position, though it may also frequently be seen advancing in a slow, shuffling manner, shouldering its way, as it were, through the crowd of parasites surrounding it. While it remains stationary in position it is otherwise briskly in motion. The head is more active than the body, continually elongating and shortening, and directing or bending its apex from side to side, or rolling it backward upon itself into a helix, now in one and then in an opposite direction. The body also elongates or shortens, becoming narrower or wider, or it widens at the base and abruptly tapers to either a pointed or more or less blunt extremity; or it assumes an oval form of variable length and breadth, or it may become quickly incurved on one side, or make a half twist upon itself. The shorter cils wave incessantly outwardly, while the longer ones are constantly rising and falling in a somewhat rhythmical manner.

Some individuals of *Trichonympha* undergo dissolution in the ordinary liquids of examination* almost immediately after being discharged from their natural habitation, while others remain comparatively unchanged for variable periods extending from a few minutes to the whole day. As the animal weakens it

* I have usually employed for the examination of the Termite parasites neutral salt solution, aqueous humor of the eye, and diluted albumen of the egg.

assumes a symmetrical quiescent form and the longer cils cease movement, while the shorter ones will still retain their activity. When it dies it becomes spherical, and the contents break up into clear vesicles mingled with more defined granules; and the contents of the nucleus shrink from its apparent wall.

Trichonympha commonly ranges from 0.075 to 0.09 mm. in length by 0.035 to 0.045 mm. in breadth. Large individuals in active movements may elongate to 0.115 mm. by 0.03 mm. in breadth, and the same by contraction, together with depression of the head may shorten to 0.06 mm. and widen to 0.05 mm. Individuals in an extreme state of shortening and proportionate widening, as often seen, when the animals are first observed, measured 0.036 mm. long by 0.051 mm. broad to 0.084 mm. long and 1.108 broad. Extreme length of an animal to the end of the terminal twist of cils measured 0.135 mm. The extreme lateral spread of the cils in an individual reached 0.24 mm. The central nucleus of *Trichonympha* is from 0.012 mm. to 0.015 mm. in diameter.

Among the tumultuous crowd of Termite parasites there are many which I have suspected to pertain to immature stages of *Trichonympha*, though I have not been able to verify the suspicion. The young, as I suppose them to be, present considerable variety in size and shape. Individuals of the kind are represented in Figs. 12-21, though it is difficult to obtain satisfactory views of their form and structure, partly on account of their delicacy, lively movements, and thick investment of cils, and partly from their quickly undergoing change of shape and dissolution.

The smallest individuals thus attributed to *Trichonympha* are spherical, ovoidal, or pyriform, 0.009 mm. to 0.012 mm. in diameter, or about as long as the latter measurement, and as broad as the former. Larger individuals of elliptical form, narrowing in front and obtusely rounded or sometimes truncate behind, measure from 0.035 mm. to 0.045 mm. in length with little more breadth than the smaller ones. The greater number of immature individuals are fusiform with the anterior extremity somewhat produced and mammilliform, or it may be more conical and pointed, while the posterior extremity is acute, or not unfrequently more or less prolonged into a caudate appendage of variable shape. These forms range from 0.03 mm. to 0.055 mm. in length by 0.015 mm. in breadth; but occasionally they range from the latter length to 0.09 mm., and from the latter breadth to 0.018 mm. Rarely some fusiform individuals were observed ranging from 0.1 mm. long by 0.02 mm. wide to 0.16 mm. long and attenuated to 0.012 mm. wide.

The supposed immature *Trichonymphæ* do not exhibit the conspicuous division into two parts, nor the distinctness of structure presented by the perfect animal.

They, however, show what seems to be an approach to both conditions indicated. Their structure consists of an indistinctly granular basis with coarser granules, but the anterior extremity to a variable extent is clearer or devoid of the coarser granules, and there is no trace of differentiation between endosarc and ectosarc. A nucleus if present is completely obscured from view.

Cils clothe the entire body of the young *Trichonympha*, and though of considerable length are not remarkably so as in the mature animals, nor do they exhibit the distinction of several ranks or series as in the latter. The cils appear to originate in opposite spiral lines crossing each other, and give to the animal a more or less imbricate appearance with a serrated aspect on the lateral outlines. The cils fold backward and outward from the head and become longer posteriorly.

The young *Trichonympha* advances, in a rather slow, shuffling manner, wriggling slightly from side to side, and sometimes elongating and shortening. The cils wave with moderate rapidity in a flowing manner outwardly and backward.

Sometimes individuals are to be seen intermediate in character with those above described and the mature *Trichonympha*, as represented in Fig. 11. In this state the creature is ovoid with the narrower extremity conical and directed forward. It exhibits a marked differentiation of structure into two parts, and also a distinct central nucleus, but presents no distinction of integument. The posterior part of the body is distinctly and somewhat coarsely granular, while the anterior part is more transparent and homogeneous. The animal is invested with cils resembling those of the mature animal, but apparently starting from spiral lines on the anterior clearer division of the body. The individual represented was 0.06 mm. long by 0.036 mm. wide.

What may be said of the character and position of *Trichonympha* in the animal series? It bears considerable resemblance to a *Gregarina*. Both exhibit the same general form and division into two parts; and both possess an equally consistent integument or ectosarc impenetrable to the passage of food, and decidedly contractile. *Trichonympha* usually appears to contain more or less solid food, which, being the case, must enter by a mouth the position of which I failed to detect. *Gregarina* does not take solid food, and, therefore, needs no mouth.

The interior substance of *Trichonympha*, or endosarc in two divisions, as in *Gregarina*, is of more consistent character, and does not present the fluent condition in the latter. The nucleus of *Trichonympha* appears to occupy the anterior division of the endosarc, and is fixed in position; in *Gregarina* it occupies the posterior division of the endosarc, and is readily displaced in the flow of the latter.

Trichonympha is especially remarkable for its wonderful cloak of vibratile cils, absent in *Gregarina*, though even *Monocystis*, a related form of the earth-worm, in one of its stages, is clothed with long cils, but they appear not to be vibratile.

The absence of all trace of a vascular, nervous, and special reproductive system would exclude *Trichonympha* from the class of worms.

In conclusion, *Trichonympha* has appeared to me to be a Protozoan intermediate to the Gregarines and Infusorians, but more nearly related to the former.

PYRSONYMPHA.

Pursos, a flame; numpha, nymph.

PYRSONYMPHA VERTENS. Plate 52, Figs. 1-17.

Proc. Acad. Nat. Sci. Philad. 1877, 148.

The parasite of the Termite, distinguished by the above name, is a constant associate of *Trichonympha*, and occurs commonly even in much greater abundance. It is usually not so large, but occasionally reaches a greater size. It is of more delicate constitution, and more readily undergoes change and dissolution after removal from the intestine of its host. Very many, indeed, undergo immediate and rapid destruction on being transferred to the field of the microscope, diffused in the fluids commonly employed in such examinations, though others remain for variable periods extending to some hours with comparatively little change.

When first observed, though the animal usually remains stationary or nearly so in position, its movements are so active and varied that it is difficult to obtain a clear idea of its form and structure. In its rapid motion it gives one the impression of a flaming body. It writhes about and bends and unbends in a zigzag manner, while rapid undulatory movements pursue a longitudinal course in a more or less spiral manner from one end to the other. (See Figs. 1-6, Pl. 52.)

When the movements of *Pyrsonympha* become sufficiently retarded to permit a better view of its character, it usually appears of variable proportionate length and breadth and of clavate form, as represented in Figs. 1-6. It exhibits no distinction of parts, as in *Trichonympha*, and is composed of finely granular protoplasm mingled with variable proportions of coarser granules, but shows no clear differentiation of an integument or of ectosarc and endosarc.

The narrower extremity of the body of *Pyrsonympha*, holding an advanced position, is usually to a variable degree clearer or more transparent than the broader portion. This commonly contains variable proportions of darkly outlined, more or less angular particles, which I have viewed as solid food, consisting of

fragments of wood-fibres, vessels, and cellular tissue, derived from the food of the host. Among these sometimes wood-fibres of considerable length may be observed, as seen in Fig. 4.

The anterior end of *Pyrrsonympha* is conical, or may become more or less obtusely rounded or truncated. The posterior broader extremity is usually rounded, or more or less angular or acute. Often also it is more or less tapering, and frequently somewhat acuminate. Sometimes, too, it appears terminated by a caudal appendage of variable form and length, but this has seemed to me to be a production resulting from change due to dissolution.

The sides of the body exhibit undulating, longitudinal folds proceeding from the narrower towards the broader extremity of the body, which accord with corresponding movements of the surface. These are especially obvious along the lateral outlines of the body. The folds pursue a more or less spiral course, and from the translucency of the animals appear to decussate from opposite sides. They become more pronounced with greater activity, and often they seemingly terminate in a series of prominent points to one side of the broader extremity of the body, as represented in Figs. 1-3. At other times their deeply waving and spiral course gives the animal the appearance of a screw rotating on its axis, as seen in Figs. 8-12.

In my earlier observations on *Pyrrsonympha* I supposed the undulatory movements of the body were due to cils, though ordinarily these were not perceptible. In very many of the swarms examined with the utmost scrutiny I failed to detect these organs, especially in the large and more conspicuous forms as well as in others of somewhat peculiar character. Whether examined in the fresh and most active condition, in the decline of their power, or after the cessation of movements, the *Pyrrsonymphæ* appeared to be entirely destitute of cils, as represented in Figs. 1-4, 8-12.

In some cases variable numbers of *Pyrrsonympha*, especially smaller ones, but not unfrequently also large individuals, appeared to be invested with cils, sometimes more or less obscurely, and at others quite distinctly, as seen in Figs. 5-7.

In some later observations, in many swarms of *Pyrrsonympha*, the greater proportion or nearly all were distinctly invested with cils, as represented in Figs. 14-17. These were generally smaller than those which appeared to be entirely destitute of cils, but otherwise seemed to be identical. Many presented the usual clavate form, vigorously bending in zigzag, as in Fig. 14; others were more or less fusiform, and actively writhing, as in Figs. 16, 17. Among them were vari-

able proportions, of comparatively large size, apparently destitute of cils, like that of Fig. 4, and many like those of Figs. 8-12, upon which no trace of these organs could be detected.

Regarding all the forms above indicated, whether ciliated or nonciliated, as pertaining to *Pyrrsonympha*, I have supposed that the former condition probably was the less mature one, and that the cils were shed as the animal assumed the mature condition.

In addition to the undulating lines of the surface of the body or the ciliary investment, it would appear that *Pyrrsonympha* possesses another accessory to movement. This is usually seen, more or less distinctly, as a cord, narrow fold, or doubly-contoured line, extending from one end of the body to the other. This incessantly and vigorously waves in a rhythmical manner, commencing at the narrow and proceeding to the broad end of the body, and quickly recommencing at the former, so that the movement appears to be continuous in a circle. The waves pursue a long, angular, zigzag course, in accordance with and appearing to produce corresponding movements of the whole body. The motion of the undulating cord and of the animal together impressed me with the idea of a snake in a bag, making its presence obvious in active contortions. In a less active condition of the undulating cord of *Pyrrsonympha*, instead of the conspicuously zigzag movements of the body, it appears to produce a writhing motion. In the process of dissolution of the animal, the undulating cord often appears to project to a variable extent from the narrower end of the body. After death it remains more or less persistent, as seen in Fig. 13. Viewed on end, while *Pyrrsonympha* remains nearly or quite stationary in position, the zigzag motion of its body, seemingly due to the vigorous action of the undulating cord, gives it the appearance of a rotating wheel with an angular tire.

With the incessant zigzag motion, or the less conspicuous one of the body, less vigorous but rapid undulatory movements proceed in longitudinal more or less spiral lines of the surface, giving to the animal the appearance of a flame.

A large nucleus is present in *Pyrrsonympha*, though in the most active condition of the animal it is more or less obscured, and often is completely concealed by other contents of the body, but becomes quite evident in dissolution of the latter. It usually occupies a position in the narrower extremity in advance of the middle, but occasionally is situated in the broader part. It is oval or round, and often appears ovoid or pyriform, with the prolongation in advance.

When *Pyrrsonympha* undergoes dissolution and dies, it discharges most of the

contents of the body, and assumes an oval or spherical shape, while the nucleus becomes more distinct, and the undulating cord remains more or less persistent, as seen in Fig. 13.

Pyrsonympha commonly measures from 0.1 mm. long by 0.03 to 0.04 mm. wide at the broader part, to 0.15 mm. long by about the same width. The longest individual measured was 0.16 mm. long by 0.033 mm. wide. The nucleus measures 0.016 mm. in diameter, or in oval form 0.024 mm. by 0.012 mm. The screw-like nonciliated forms, such as represented in Figs. 8-12, commonly range from 0.075 mm. long by 0.015 mm. wide to 0.12 mm. long by 0.015 to 0.025 mm. broad; but often equal the others in size. Distinctly ciliated individuals, elongated and fusiform, measured 0.075 mm. to 0.09 mm. long by 0.009 mm. to 0.012 mm. wide; and the clavate forms 0.06 mm. to 0.075 mm. long by 0.018 mm. to 0.024 mm. wide.

Pyrsonympha, though usually observed in a stationary position while it bends and unbends, or writhes from side to side, may sometimes be seen moving about in a slow, shuffling manner. Though it appears to take solid food, I was unable to detect the mode of its entrance. At no time did I detect within the animal distinct vacuoles or a contractile vesicle.

The animal I take to be a ciliated Infusorian, though in many individuals, perhaps in a particular stage of life, the cils appear to be absent.

DINENYMPHA.

Dine, whirl; numpha, nymph.

DINENYMPHA GRACILIS. Plate 52, Figs. 18-26.

Proc. Acad. Nat. Sci. Philad., 1877, 149.

To the parasitic community of our Termite belongs the animal above named. It is a ciliated Infusorian, probably related with the familiar genus *Opalina*, though, unlike this, and like its associates, it appears to swallow solid food. Since I have had the opportunity of observing ciliated forms of *Pyrsonympha*, I have suspected that perhaps this also is only a younger stage of the former. The body is a simple band with tapering extremities and pointed ends. It is longitudinally striated, and is translucent, pale, and indistinctly granular, without a clear differentiation into endosarc and ectosarc. Commonly the central portion of the body contains variable proportions of coarse granules, and some irregular particles probably of the nature of food, and seemingly minute fragments of wood-fibre derived from the food of the Termite. Not unfrequently one or several

clear globules may be seen, which are probably vacuoles. Usually a nucleus could not be detected, but on dissolution of the animal one becomes more or less evident in the forepart of the body.

Dinenympha is everywhere closely invested with short, rapidly-vibrating cils; distinctly obvious along the outline of the body. In many instances individuals appear with the head end furnished with a sort of crest, or radiant fascicle of longer cils, as represented in Figs. 25, 26. In most cases the crest was not obvious, and when present I have suspected that perhaps it was illusory, and due to the temporary adherence of *Vibrios*, which occur as an abundant associate of the animal parasite.

Dinenympha is an active creature incessantly in motion, though like its associates it remains nearly or quite stationary in position. It always appears twisted, or presents from one to three spiral turns on its long axis, so that it seems to be in constant rotation, while it writhes about and alternately elongates and shortens. The anterior end also bends in one and then in another direction, and is often alternately somewhat projected and withdrawn. Sometimes the animal slowly advances in a shuffling manner, alternately inclining from side to side. In its apparent rotary movement the longitudinal striæ of the body become more or less pronounced, and at the lateral borders of the turns of the spiral induce a dentated appearance. *Dinenympha* ranges from 0.045 mm. to 0.096 mm. in length by 0.006 mm. to 0.012 mm. in breadth.

On one occasion only in a single Termite I observed numerous *Dinenymphæ*, in which the body contained a variable number of comparatively large, spore-like bodies, as represented in Fig. 22. They were oval, darkly outlined, translucent, homogeneous, oil-like in appearance, and measured about 0.006 mm. by 0.0045 mm. Usually there were two or three, but ranged from one to five or more. A number together always formed a single row, and they appeared flattened at the points of contact.

These bodies I supposed might be spores or reproductive bodies of the *Dinenympha*, but I also observed a number of the young *Trichonympha*, as represented in Fig. 21, Pl. 51, containing variable numbers of the same kind of bodies. Nevertheless these may be spores of the *Dinenympha*, which after expulsion had been swallowed by the *Trichonympha*. It has further occurred to me that they might be spores of some parasite of the parasites named.

Occasionally I have observed a nucleus in *Dinenympha*, occupying a nearly central position.

ISACIS.

ISACIS MIGRANS.

Lespes. Annales Sci. Nat. V., 1856, 335.

In numerous examinations of the parasites of our Termite, always directed to those of the intestines, I but once met with an individual of the thread-worm, which I recognized as the *Isacis migrans*, discovered by M. Lespes in the Termite of France. While in the act of writing the present notice of the worm, I laid down my pen and reflected upon its comparative rarity in our Termite. Recalling to mind the frequent occurrence of a nematoid parasite in the proboscis of the common house-fly, it occurred to me that the *Isacis* might inhabit the head of the Termite. Having a colony of the latter on my table, I at once took two individuals and examined their heads, and behold in a moment I had displayed beneath the microscope about a dozen individuals of the *Isacis*.

In the Termite of France, and likewise in our own, the *Isacis* occurs in an immature condition; that is to say, without the generative apparatus being developed. In the mature state M. Lespes found the worm in earth of the nest of the Termites, and it is probable that it will be found in the same state under like circumstances with our Termites.

GREGARINA

GREGARINA TERMITIS. Plate 52, Fig. 27.

A small *Gregarina* was once noticed in our Termite, and is represented in Fig. 27. The body is ovoid with the narrower end posterior. The head spheroid compressed from above downward. Length 0.06 mm.; head 0.018 mm. long, 0.03 broad; body 0.036 mm. broad.

Of the vegetal parasites found in association with the animal forms, within the small intestine of our Termite, there are two kinds: one a species of vibrio, the other an attached algoid, to which I formerly gave the name of *Arthromitus*.

VIBRIO.

VIBRIO TERMITIS. Plate 52, Figs. 36-39.

Vibrios occur in great numbers as an associate of *Trichonympha*, *Pyrsonympha*, and *Dinenympha*. They resemble most nearly the *Vibrio serpens* of Müller, as described by Dujardin, Cohn, and others. Under the highest powers of the microscope at my command, one-tenth objective of Wailes, of Smith and Beck, and No. 11 immersion objective of Hartnack, they appear as immeasurably fine lines, usually ranging from 0.03 mm. to 0.045 mm. in length; but in

extreme ranging from 0.015 mm. to 0.06 mm. in length. They usually appear rectilinear and regularly undulant with from three to five or six waves. They commonly remain stationary in position and undulate more or less rapidly, but they often advance or recede with variable rapidity, and sometimes become quiescent. Occasionally they bend at an obtuse angle while continuing to undulate, and sometimes they become zigzag. Mostly they wave with regularity, sometimes irregularly, and occasionally the ordinary number of their waves is doubled. The smallest individuals, 0.015 mm. in length, are straight, but in movement become bent in the segment of a circle or become sigmoid.

The vibrios move in all directions among their associates. Not unfrequently numbers adhere together by one end and form radiating groups, as represented in Fig. 38.

ARTHROMITUS.

Arthron, a joint ; mitos, a thread.

ARTHROMITUS CRISTATUS. Plate 52, Figs. 28-34.

Leidy. Proc. Acad. Nat. Sci., IV., 1849, 227. A Flora and Fauna within Living Animals, Smithsonian Contributions, 1851, 34.

The name of *Arthromitus* was originally given by the author to a supposed undescribed genus of delicate filamentous plants, found growing within the intestine of certain myriopods, *Spirobolus marginatus* and *Polydesmus virginiensis*, and of the coleopterous insect *Passalus cornutus*.

The characters of the genus *Arthromitus* are as follows: Plant in the form of exceedingly fine delicate filaments, usually attached by an attenuated extremity and growing isolated or in small divergent groups. Filaments always simple, cylindrical, of uniform diameter, homogeneous, and inarticulate, or more or less distinctly articulate, with the free end slightly expanded or narrowed, and rounded or truncated. Articuli mostly cylindrical, with little difference of length and breadth, sometimes feebly keg-shaped, homogeneous. Spores mostly in a series occupying the distal articuli, always single, oval or oblong, darkly outlined, translucent, and homogeneous.

Among the profusion of parasites obtained from the small intestine of our Termite almost always a number of filaments may be observed with the characters above ascribed to *Arthromitus*. They are usually observed loose, and have been probably detached from their points of growth. When attached they appear to spring singly or in groups of several together from a granule or minute round disk adherent to the epithelium of the intestine.

The finest filaments appear homogeneous and inarticulate. The larger and mature filaments, or those bearing spores, as represented in Figs. 28-32, reach half a millimetre or more in length, and measure from 0.0015 mm. to 0.00375 mm. in thickness. Usually at their distal portion they exhibit a more or less long series of spores, distinctly defined, giving to the filaments the appearance of minute rows of beads. The number of spores in a row is variable, and sometimes several rows occur, with a short interval, in the same filament.

The spores are commonly oval or oblong, and lie longitudinally at pretty uniform distances apart; but occasionally they are a little oblique. They are strongly marked, darkly outlined, transparent, and homogeneous, and resemble minute oil-drops. Under a favorable disposition of the light each is seen to occupy a separate articulation, and the partitions separating them are more or less distinctly observable, as represented in Figs. 31, 32.

Commonly the spores measure about 0.003 mm. long by 0.0022 mm. broad.

Sometimes filaments occur in which the spores lie together in pairs with a slight separation between each spore, and wider spaces between the pairs, as seen in Fig. 28. Other filaments appear in which the spores are proportionately much longer than usual, and separated by wider intervals, as seen in Fig. 30. It would seem from these latter kinds of filaments, as if the longer form of spores underwent division in the production of the pairs.

The filaments below the spore-bearing portions sometimes appear slightly more attenuated and less distinctly or not articulated.

Occasionally finer, homogeneous filaments of the plant grow upon the more mature ones, as represented in Fig. 32.

The *Arthromitus* of the Termite, by comparison with specimens of *Arthromitus cristatus*, from our Wood-Julus, recently examined, prove the plants to be the same. A bunch of *Arthromitus* from the latter animal is represented in Fig. 33. The spore-bearing filaments are about the same size as in those of the Termite, but frequently they present more numerous or longer rows of spores, and in the filaments without spores an articulated condition is at times more evident.

In some of the spore-bearing filaments from *Julus*, it was observed that the articulations appeared less well defined than usual, as if softened, and they were finely granular, as represented in Fig. 34. The condition was supposed to indicate the means by which the spores may be discharged. Attached to some of the apparently softened filaments there were many small, narrow, elliptical bodies, which appeared to be germinating plants. They were not derived from the spores, than which they were smaller, but started from minute granules, seemingly some of those derived from the softening articulations.

It becomes a question as to the claim of *Arthromitus* being a genus distinct from others previously proposed or established.

Valentin (Repertorium f. Anatomie, 1836) described a parasitic plant from the large intestine of *Blatta orientalis*, and from the rectum of *Astacus fluvialis*, under the name of *Hygrocrocis intestinalis*, which would appear to have the same generic character as *Arthromitus*. Not having access to the original description, I quote the diagnosis as given by M. Ch. Robin (Histoire d. Vegetaux Parasites, 1853): "Fila simplicia, tenuissima, perlonga (articulata?), serpentia, apice recta (monili-formia? articulis globosis?)." This would apply to the plants I have referred to *Arthromitus*, except in the latter two characters, which, however, are questionable with the author as applied to *Hygrocrocis intestinalis*.

Recently I was so fortunate as to catch a large cockroach, *Blatta americana*, when I proceeded to examine the large intestine with the expectation of finding the same parasitic plant as that discovered by Valentin in the *B. orientalis*. Surely there it was in abundance, in association with the usual animal parasites, and in it I recognized *Arthromitus*; but with sufficient peculiarity, perhaps, to view it as a species distinct from that of our Wood-Julus and Termite.

The *Arthromitus* of our cockroach consists of simple filaments, about the same diameter as those of the Julus and Termite. The stouter spore-bearing filaments, as represented in Fig. 35, Pl. 52, exhibited more numerous or longer rows of spores which were of the same form as those of *Arthromitus cristatus*, but were differently disposed. They were transversely situated, often alternating in direction, as seen in the figure. Occasionally they were oblique, but in no instance longitudinal. This difference of position is due to the difference in the proportionate size of the articulation in the two forms of *Arthromitus*; the joints in that of the cockroach being broader than long, while in *A. cristatus* the condition is reversed. In the latter the lines of separation of the articulations are commonly most readily detected between the ripe spores, but in the *Arthromitus* of the cockroach the partitions were better seen in the filament below the spore-bearing portion, as seen in Fig. 35.

I have assumed that the *Arthromitus* of the *Blatta americana* is the same as the *Hygrocrocis intestinalis* of the *Blatta orientalis*, though it may be different.

The genus *Hygrocrocis* was originally proposed by Agardh (Systema Algarum, 1824), on certain fine filamentous plants, growing in chemical solutions, which are rather of the nature of Fungi. Rabenhorst excludes it from his Flora Europæa Algarum, and in a note indicates it as pertaining to the Fungi.

M. Robin refers the *Hygrocrocis intestinalis* of Valentin to the genus *Lepto-*

thrix. The characters of this, as originally established by Kützinger (Phycologia Generalis, 1843, 150), are as follows: "Trichomata ex articulis globosis vel ellipticis, solidis, non vaginatis, minutissimis, arcte conjunctis composita, plerumque moniliforma, aut libera, aut in stratum lubricum, amorphum implicata." The genus included minute filamentous algæ growing parasitic on other and longer algæ, and on other aquatic or submerged plants and on rocks.

M. Robin also refers the algous filaments growing on the human teeth to the same genus, under the name of *Leptothrix buccalis*. The fine threads of this are inarticulate, homogeneous, and without evident spores. Rabenhorst (Flora Europæa Algarum, I., 1865, 73) says of the subfamily to which *Leptothrix* belongs: "Propagatio adhuc ignota."

The essential characters of *Leptothrix* apply sufficiently well to the parasitic algæ I have described under the name of *Arthromitus*, but as the spores of the former remain unknown, it would, perhaps, be of doubtful propriety in the present condition of our information to drop the latter name.

M. Robin further describes a parasitic plant, found in the rectum of *Julus terrestris*, and in *Dytiscus marginalis* under the name of *Leptothrix insectorum*. While I suspect that this may pertain to *Arthromitus*, the figures of the filaments exhibit a structure such as I never saw in the latter, and they show no spores such as pertain to *Arthromitus*.

In conclusion, as if to fill up the measure of life capable of being sustained by the Termite, it is infested with a mite, a species of *Gamasus*.

REFERENCES TO THE PLATES.

PLATE 51.

TRICHONYMPHA AGILIS. All the figures magnified 666 diameters.

- Figs. 1-3. Side views of three individuals, seen immediately after escaping from the intestine of the Termite. The head more or less depressed within the body, and the third rank of cils widely spread. The central nucleus distinctly visible. In these views the animal appears broader than long.
4. An individual as seen from above or below, with the cils extended in four chief divisions.
 5. Side view of an individual fully extended.
 6. The same individual as seen with the head rolled into a helix.
 7. Side view of an individual with the body much shortened and widened, and containing, besides the usual nucleus, two large, coarsely granular balls, supposed to be masses of spores.
 8. Individual with the body shortened and widened and with the head enrolled into a helix. The nucleus apparently contained within the sunken endosarc of the head.
 9. Side view of an individual. The usual nucleus inclosed within a larger sphere.
 10. Similar view of another individual.
 11. Side view of an apparently immature individual.
 - 12, 13. Apparently less mature individuals, with a seemingly imbricated arrangement of structure, and no visible nucleus.
 - 14-20. Similar views of different individuals supposed to be immature forms of the same animal.
 21. View of an individual of the same kind, containing numerous spore-like bodies.

PLATE 52.

Figs. 1-17. *PYRSONYMPHA VERTENS*. All 666 diameters.

1. Side view of a nonciliated individual in zigzag movement, together with lateral undulating motion of the borders in the direction of the arrows. The interior nucleus visible.
2. An individual extended, the zigzag motion retarded. The nucleus pyriform; the prolongation apparently the result of change. A large quantity of food visible in the broad part of the body.
3. An individual exhibiting an extreme condition of zigzag bending.
4. A large individual, after slackening in its zigzag motion. Several long wood-fibres visible in the interior.
- 5-7. Three ciliated individuals. All with the nucleus visible, and all containing some particles of wood-fibre.

- 8-12. Five apparently nonciliated individuals with rapid undulating movement in spiral lines.
13. A dead individual retaining the nucleus and undulatory cord.
14. Lateral view of a ciliated individual.
15. End view of the same.
- 16-17. Two ciliated individuals of narrow fusiform shape.
- 18-26. *DINENYMPHA GRACILIS*.
18. A large individual, containing considerable food. 666 diameters.
- 19-21. Three individuals, exhibiting different forms assumed in movement. 750 diameters.
22. Individual, containing a row of spore-like bodies. 666 diameters.
- 23, 24. Two small individuals. 666 diameters.
- 25, 26. Two individuals, apparently with a fascicle of long cils at the upper end. 500 diameters.
27. *GREGARINA TERMITIS*. 666 diameters.
- 28-34. *ARTHROMITUS CRISTATUS*. All 1333 diameters except Fig. 33, which is 666 diameters.
28. Filaments with spores in pairs, separated by wide intervals.
29. Filaments with slightly oval spores.
30. Filament with elongated spores.
31. Comparatively robust filament with spores, arranged as usual, with the partitions of the articulation visible.
32. A robust filament, with spores and distinct articulations, and with young plants attached.
33. A bunch of *Arthromitus* from *Spirobolus marginatus*.
34. Portion of a filament, with spores, the articulations of the filament granular in appearance, and with attached germinating granules.
35. *ARTHROMITUS INTESTINALIS*. From the large intestine of *Blatta americana*. 1333 diameters. The spores seen in a transverse position.
- 36-39. *VIBRIO TERMITIS*. 333 diameters except those of Fig. 39, which are 666 diameters.

Remarks on Bathygnathus borealis.

BY JOSEPH LEIDY, M.D.

A PAPER by the author, published in this Journal in 1854, gives an account of an interesting fossil from the red sandstone of Prince Edward's Island, described under the name of *Bathygnathus borealis*. The specimen, now preserved in the museum of our Academy, consists of one side of a jaw with teeth imbedded in a slab of red sandstone, and is well represented in the chromo-lithographic plate accompanying the paper mentioned.

Prof. Owen, in a paper published in the Quarterly Journal of the Geological Society of London for 1876, has referred *Bathygnathus*, together with a number of other extinct genera of reptiles from the Permian formations of the Urals and South Africa, to an order under the name of *Theriodonts*. In my understanding of the characters of this order so far as they are derived from the teeth, it would appear that in their differentiation, arrangement, and mode of insertion in the jaws they exhibit mammalian affinity, especially to the carnivores, more than usual among reptiles, and hence the name of *Theriodonts*. Though such may be the case with the more immediate representatives of the order, it seems to me the characters do not apply to *Bathygnathus*, not even so much as in crocodiles.

In my description of *Bathygnathus* Prof. Owen has pointed out, what now appears to me to be a most egregious blunder, the reference of the fossil to the mandible. Truly it appears to me to pertain to the upper jaw, and I can only wonder at my mistake. In some other points Prof. Owen has misunderstood me, and has fallen into error in regard to several anatomical features of the fossil.

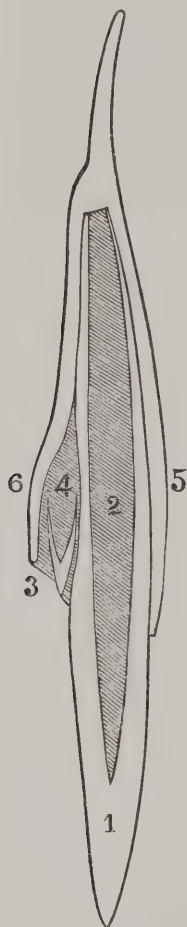
"The teeth," says Prof. Owen (p. 359) "are implanted in distinct sockets, and have subcompressed, recurved, conical, acuminate crowns, with anterior and posterior trenchant borders, of which the latter is minutely crenulated." This does not exactly accord with my account, and I, therefore, redescribe them.

The teeth have compressed, recurved, conical crowns with anterior and posterior trenchant borders, both of which are distinctly crenulated. The borders are directed to the inner aspect of the crowns, the faces of which are more or less depressed contiguous to the borders, especially behind. The teeth resemble those of some of the recent Monitors and those of *Megalosaurus*, but are proportionately

narrower than in this genus. The complete relation of the teeth with the jaw in the fossil cannot be clearly ascertained on account of the inner side of both being so intimately imbedded in the sandstone matrix, but, so far as it can be learned, the evidence would appear to indicate an arrangement essentially the same as in *Megalosaurus* and modern Pleurodont saurians.

The mature teeth appear anchylosed with their sockets, and they would appear to have been shed and succeeded in the same manner as in the reptiles just mentioned.

The fossil is irregularly broken through in the course of the insertion of the largest tooth, viewed as a canine by Prof. Owen, and in this course the arrangement appears to be as represented in the accompanying diagram. The larger tooth, deeply implanted and firmly anchylosed with its socket, has the outer wall of this reaching half an inch lower than the inner wall. Lodged between the latter and the large tooth, protruding from the same alveole, and imbedded in the sandstone matrix, is the summit of a successional tooth.



1. Section of large tooth.
2. Its cavity filled with matrix.
3. Successional tooth contained in the inner part of the same alveole.
4. Matrix.
5. Outer wall of the alveole.
6. Inner wall.

Prof. Owen's paper is accompanied by a wood-cut, representing the fossil of *Bathygnathus*, taken from the plate accompanying my paper. In the cut the teeth back of the canine are partly numbered as molars, and might give the impression that there were not more than seven, whereas the fossil exhibits positive evidences of a series of nine teeth posterior to the canine. In advance of the latter the fossil contains a small tooth, remaining from a series in this position apparently of three. The small tooth, viewed as an incisor by Prof. Owen, is much worn fore and aft from friction of opposing teeth, leaving some doubt as to whether it accorded in form with the teeth

behind. It is proportionately less compressed, but exhibits a portion of a back trenchant border with a slight trace of crenulation.

Viewing the fossil as pertaining to the upper jaw, the bone would appear to comprise the great part of the maxilla, premaxilla, and nasal, though the limits of these I cannot ascertain with any satisfaction. This is rendered the more diffi-

cult from lines of fracture traversing the surface, as well as from more marked mutilation of the specimen. An oblique line or fissure, a fourth of an inch in advance of the fracture, following the course of the larger tooth, partially only and not well represented in the plate, may indicate the suture between the maxilla and premaxilla. Another line, rather more than an inch below the upper oblique border of the bone, may indicate the nasomaxillary suture.

If the natural condition of the portion of the face is preserved in the fossil, the bone as a whole expresses a remarkable proportionate depth and narrowness or lateral compression, though the latter may, perhaps, be in a measure due to some crushing. The side of the face presents a broad almost vertical surface, nearly flat over the alveolar parapet, and forming a wide concavity above.

No portion of the orbital margin is perceptible in the fossil, and the limit of the maxilla behind and below is attenuated to the thinness of paper where it articulated with the malar.

The surface of the face is marked fore and aft by many vascular grooves, though no conspicuous vascular foramina are observed. The upper limit of the fossil is convex, and formed apparently by the nasal bone, which is from a line to a line and a half thick.

Prof. Owen points out a space, marked *n* in his figure, which he suspects to be "evidence of an external nostril." This is a mistake, and as seen in the plate accompanying my paper is a vacuity left on the matrix by the breaking away of a portion of bone. In advance and below this, however, in the same plate, there may be observed a circular, funnel-like space, partly inclosed by the bone with a thickened, rounded border, which may fairly be suspected of being the external nasal orifice.

In conclusion, while it appears to me that the fossil referred to *Bathygnathus* has little affinity with *Lycosaurus* and other representatives of the *Theriodonts*, its more intimate relationships are with *Megalosaurus* and *Teratosaurus*.

INDEX TO GENERA.

- | | | |
|--|---|---|
| <p> Ablades, 138
 Achaenodon, 72, 78, 80, 84, 88
 Aciona, 190
 Acirsa, 190
 Aclis, 358
 Actæonella, 281
 Acrilla, 190
 Acrodobatis, 250
 Adeorbis, 365
 Ætobatis, 244
 Agalychnis, 95, 107
 Agaria, 288
 Ahaetulla, 132
 Alodes, 95
 Amiva, 116, 157, 165
 Ammonites, 264
 Amoea, 190
 Amphisbæna, 176
 Ampullina, 264
 Anaplotherium, 73, 79
 Anchippodus, 76, 81
 Ancistrodon, 149
 Anchitherium, 74, 76
 Anodonta, 67
 Anolis, 95, 119, 157, 165
 Anomia, 295, 380
 Anthracotherium, 79
 Arca, 264, 291, 345, 378
 Architectonica, 359
 Artemisia, 94
 Arthromitus, 427, 442, 444
 Arvicola, 71, 72
 Assimineæ, 408
 Astarte, 376
 Atelopus, 94, 95, 96, 102
 Atlanta, 349
 Atropis, 405
 Avicula, 290
 Axinæa, 346, 378 </p> | <p> Barbatia, 290
 Basiliscus, 125, 156
 Bathmodon, 71, 73, 75, 77, 83, 88
 Bathygnathus, 449
 Belemnoziphius, 226
 Beluga, 72
 Boa, 130, 177
 Bothriechis, 94, 95, 149, 150
 Bothriopsis, 149, 150
 Bothrops, 131, 151, 181
 Botriopygus, 300
 Bradypus, 72
 Brontotherium, 87
 Bufo, 94, 96, 99, 155
 Bulla, 370
 Bunotherium, 89
 Bursa, 353

 Caecum, 363
 Calliostoma, 366
 Callista, 344, 372
 Carcharodon, 236, 253
 Cardiocardites, 288
 Cardita, 287, 288, 377
 Cardium, 264, 286, 344, 374
 Caryatis, 373
 Cassidaria, 356
 Cassidea, 356
 Cassis, 356
 Castor, 71
 Catostoma, 94, 146
 Cemophora, 142
 Centropyx, 162
 Ceratoptera, 248
 Cerithium, 264, 360
 Cervus, 85
 Ceterhinops, 230
 Chalcidolepis, 95, 116 </p> | <p> Chalicotherium, 85
 Chama, 375
 Chamaeleolis, 166
 Chelopus, 153
 Chilomeniscus, 141
 Chinchilla, 72
 Chionactis, 142
 Chiromys, 71
 Chæromorus, 84
 Chondrëlla, 407
 Choneziphius, 218
 Cinosternum, 153
 Cinulia, 280
 Cirsotrema, 190
 Clathrus, 190
 Clementia, 344
 Cnemidophorus, 164
 Coecilia, 155
 Coenotherium, 87
 Coleonyx, 118
 Colobognathus, 95, 148
 Colosteus, 95
 Columbella, 355
 Coniophanes, 137
 Conophis, 95, 137
 Conopsis, 141
 Contia, 94, 145
 Conus, 359
 Corbula, 283, 343, 370
 Corythophanes, 124, 156
 Craniopeltis, 159, 173
 Cranopsis, 94, 96
 Crassatella, 287, 345
 Crenella, 377
 Crepidius, 94, 97
 Crocodilurus, 162
 Crotalus, 95, 152
 Cucullæa, 291
 Cyclina, 344 </p> |
|--|---|---|

- Cycloramphus, 159
 Cyclura, 95, 124
 Cylichna, 369
 Cyphoma, 360
 Cypræa, 360

 Delphinus, 72
 Dendrobates, 94, 102
 Dendrophidium, 134
 Dentalium, 369
 Diadema, 404
 Dicotyles, 71, 72, 73, 84
 Dicrodon, 162
 Didelphys, 86
 Dinonymphe, 439
 Dinotherium, 76, 80
 Dinoziphius, 216
 Diodon, 255
 Dioplon, 226
 Diploglossus, 118
 Diprotodon, 86
 Dipsas, 95, 131, 177
 Discoidea, 300
 Distortio, 353
 Donax, 371
 Doryphorus, 171
 Drillia, 337, 351
 Driophis, 95
 Dromicus, 139
 Drymobius, 95, 135, 179
 Dryophis, 132
 Dryophis, 177

 Eboroziphius, 224
 Echinus, 299
 Elaps, 95, 148, 181
 Elephas, 73, 76, 80, 88, 212, 413
 Elotherium, 72, 73, 80, 84
 Endodonta, 389
 Engystoma, 101
 Enicognathus, 138
 Ennalaster, 301
 Enterobryus, 426
 Enyalius, 169
 Eobasileus, 71, 73, 77, 88
 Epaphelus, 115
 Epicrates, 95, 130
 Equus, 78, 86, 88, 212
 Erythrolampus, 141
 Eucetes, 216
 Eulima, 358

 Eunectes, 177
 Eupachemys, 232
 Euspira, 264
 Exogyra, 297

 Fasciolaria, 354
 Ficimia, 141
 Fissurella, 369
 Fusulina, 303
 Fusus, 264, 350

 Galeocerdo, 254
 Gamusus, 445
 Gastrochaena, 210
 Geagras, 141
 Geomys, 72
 Gerrhonotus, 95, 118
 Gerrhosteus, 177
 Gibbula, 366
 Glyptodon, 71, 72
 Gnathophysa, 113
 Goniobasis, 61, 62
 Goniodyctylus, 176
 Gouldia, 376
 Gregarina, 431, 435, 441
 Grythæa, 298
 Gryphodobatis, 249
 Gyalopium, 141
 Gyrodes, 276

 Halitherium, 80
 Halmaturus, 86
 Helcion, 282
 Helicina, 406
 Helicops, 181
 Heliscomys, 72
 Helminthophis, 128
 Helotherium, 82
 Hemipristis, 254
 Herpetodryas, 95, 132, 134, 135, 178
 Hipparion, 212
 Hipponyx, 364
 Hippopotamus, 78, 87
 Hipposyus, 82
 Homo, 71, 73
 Homomya, 285
 Hygrocrocis, 444
 Hyla, 94, 103, 155
 Hylodes, 94, 112
 Hylorana, 114

 Hyopotamus, 73, 77, 79
 Hyopsodus, 72, 78, 81, 88
 Hyperoodon, 226
 Hyperanodon, 170
 Hypohippus, 82
 Hypopachus, 101
 Hypsibates, 171
 Hypsiprymnus, 86
 Hyrachyus, 73, 76
 Hyracodon, 76
 Hyrax, 74, 76

 Iguana, 124, 169
 Isacis, 428, 441

 Janira, 347, 379
 Julus, 426

 Kuphus, 342

 Lachesis, 152
 Laimodonta, 403
 Lamna, 254
 Latirus, 354
 Leina, 293
 Lepidosoma, 160
 Leptognathus, 130, 177
 Leptophis, 132, 177
 Leptothrix, 445
 Lepus, 71, 72
 Libera, 390
 Ligonirostra, 142
 Lima, 348
 Limax, 402
 Limnohyus, 85
 Limnotherium, 78, 81
 Liophis, 95, 136, 180
 Lithodytes, 94, 107, 155
 Lithophaga, 377
 Littorina, 264
 Liyla, 107
 Lophiodon, 73, 76, 80
 Lucapina, 369
 Lucina, 345
 Lunatia, 339
 Lycosaurus, 451
 Lygophis, 180
 Lygothis, 139

 Mabunia, 115, 159
 Macacus, 73

- Malea, 338
 Mamilla, 357
 Manatus, 214
 Mangelia, 351
 Margarita, 69, 366
 Marginella, 355
 Martesia, 370
 Mastodon, 72, 73, 80, 213
 Megalosaurus, 449
 Megatherium, 213
 Melampus, 402
 Melongena, 350
 Meretrix, 343, 372
 Merychys, 79
 Merycopotamus, 85
 Mesobatis, 244
 Metalophodon, 75
 Metula, 351
 Microcystis, 381
 Microlophus, 159, 171
 Microphryne, 155
 Microsypops, 81
 Mocoa, 94, 115
 Modiolaria, 377
 Modulus, 363
 Morum, 357
 Murex, 349
 Mus, 71, 73
 Myliobates, 233
 Myophoria, 289
 Mysia, 376

 Nassa, 353
 Natica, 338, 357
 Nautilus, 337
 Neithea, 294
 Neusticurus, 161
 Ninia, 95, 145
 Norops, 169
 Notharctus, 78
 Notidanus, 254
 Nucula, 292, 378
 Nuculana, 346
 Nyctotherus, 427

 Oedipus, 94
 Ogmius, 142
 Oligotomus, 81, 89
 Oliva, 338, 354
 Ollotis, 94, 98
 Omphalotropis, 405

 Opalia, 190
 Operculatum, 370
 Opheobatrachus, 94, 96
 Ophemorphus, 180
 Oreodon, 73, 77, 79
 Orestias, 185
 Orohippus, 82
 Orotherium, 89
 Ostrea, 264, 296, 348, 380
 Otodus, 236
 Oxyrhina, 254
 Oxyrrhopus, 131, 177

 Palæochærus, 84
 Palæosyops, 73, 75, 76, 81, 88
 Palæotherium, 73, 76, 80
 Panopæa, 282
 Papyridea, 375
 Parkeria, 368
 Partula, 395
 Passalus, 427, 442
 Patula, 384
 Pecten, 293, 346, 379
 Pelamis, 95, 148
 Peltaphryne, 96
 Periastrer, 301
 Perissolax, 276
 Petaurus, 86
 Petricola, 210
 Petropoma, 281
 Phacochærus, 72, 86
 Pharyngodopilus, 256
 Phascalomys, 86
 Philodryas, 178
 Phocæna, 217
 Pholadomya, 284
 Pholas, 210
 Phos, 338
 Phrynobatrachus, 95
 Phyllobates, 94, 107, 155
 Phyllodactylus, 95, 118, 174
 Physa, 63
 Pinna, 345, 378
 Pitys, 388
 Placunanomia, 296
 Plicatula, 295
 Pliocercus, 138
 Pluronectia, 347
 Polychrus, 124
 Polydesmus, 442
 Porthidium, 149, 151

 Prionodon, 254
 Prisconatica, 276
 Pristis, 252
 Procamelus, 79
 Proctotretus, 159, 173
 Procyon, 72, 73, 89
 Productus, 302
 Propus, 160
 Proroziphius, 227
 Prosymna, 142
 Protocardia, 286
 Psephis, 373
 Pseudemys, 153
 Pteria, 290
 Pyrsonympha, 436, 441

 Ræta, 264
 Ranula, 94, 114
 Retepora, 303
 Rhabdosoma, 181
 Rhadinæa, 95, 138
 Rhinaster, 86
 Rhinocerus, 73, 76, 87
 Rhinobothryum, 177
 Rhinochilus, 142
 Rhinosaurus, 165
 Rhynchonella, 299, 302
 Ringicula, 358
 Rissoa, 363
 Rosmarus, 72, 214

 Scala, 189, 192
 Scalaria, 191, 357
 Scalinelia, 406
 Sceloporus, 95, 127
 Schizaster, 348
 Schizostoma, 61
 Scytale, 177
 Scytomycterus, 165
 Semele, 264, 372
 Sibon, 131, 157, 177
 Sigaretus, 339
 Siliquaria, 364
 Siphonops, 96
 Smilisca, 95, 103, 107
 Sonora, 142
 Sphærodactylus, 118
 Sphargis, 153
 Sphyraena, 254
 Spilotes, 135, 157, 180
 Spirobolus, 427

- Spondylus, 379
 Stegodon, 85
 Stenogyra, 393
 Stenorhina, 141, 142
 Stenostoma, 128
 Strombina, 356
 Strombus, 340, 360
 Styliola, 337
 Succinea, 401
 Sus, 73, 86
 Symborodon, 72, 76, 81, 88
 Sympholis, 141

 Tachymenis, 159, 180
 Tagelus, 370
 Tantilla, 95, 143, 181
 Tapirus, 73, 76, 78, 87
 Teleuraspides, 148
 Teleuraspis, 157
 Tellina, 286, 343, 371
 Telmatobius, 95
 Teratosaurus, 451
 Terebra, 340
 Terebratula, 299, 302
 Termes, 425
 Tetracaulodon, 80, 85

 Thecadactylus, 119, 176
 Thrasops, 95
 Thylacinus, 86
 Tillotherium, 75
 Titanotherium, 75, 76
 Toluca, 141
 Tomitherium, 89
 Tornatellina, 397
 Tornatina, 369
 Tortrix, 176
 Trachytherium, 80
 Trichecus, 74, 76, 80, 215
 Trichonympha, 429
 Triforis, 363
 Trigonarca, 290
 Trigonina, 288
 Trimorphodon, 131
 Trionyx, 233
 Tritonium, 352
 Trivia, 360
 Trochita, 342
 Trypheropsis, 94, 114
 Turbonilla, 358
 Turris, 350
 Turritella, 264, 279, 341
 Tylostoma, 280

 Typhlops, 176

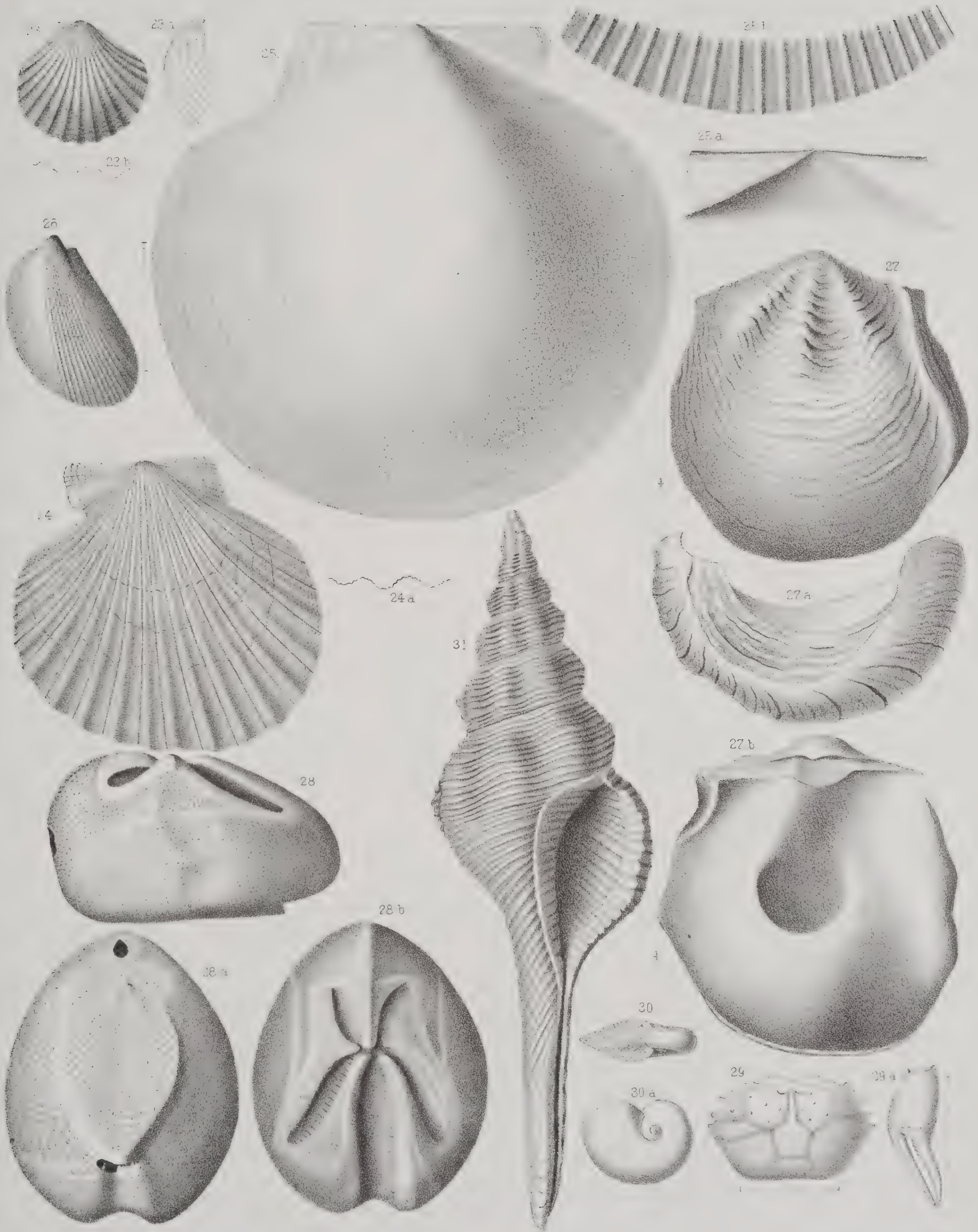
 Uintatherium, 74, 75, 88
 Unio, 5, 64, 68
 Ursus, 89

 Vasum, 354
 Venus, 372
 Vermetus, 363
 Verticaria, 165
 Vertigo, 400
 Vibrio, 441
 Vitrinella, 367
 Voluta, 355
 Volutilithes, 264
 Volutoderma, 264
 Volvula, 370

 Xenodolamia, 251
 Xenodon, 141, 157, 180
 Xiphodolamia, 252
 Xiphosoma, 129, 177
 Xylophora, 364

 Ziphius, 219
 Zylobates, 247





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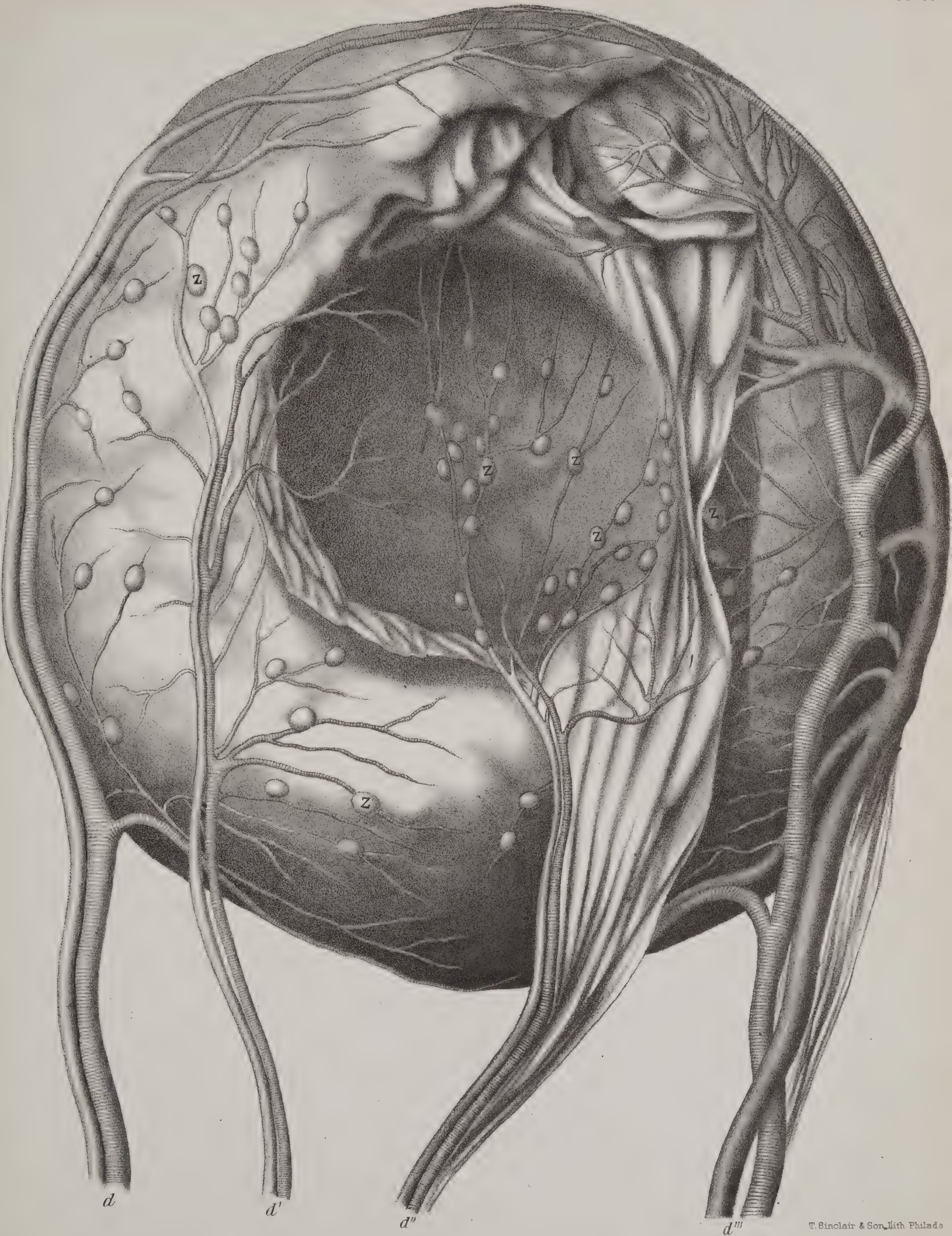
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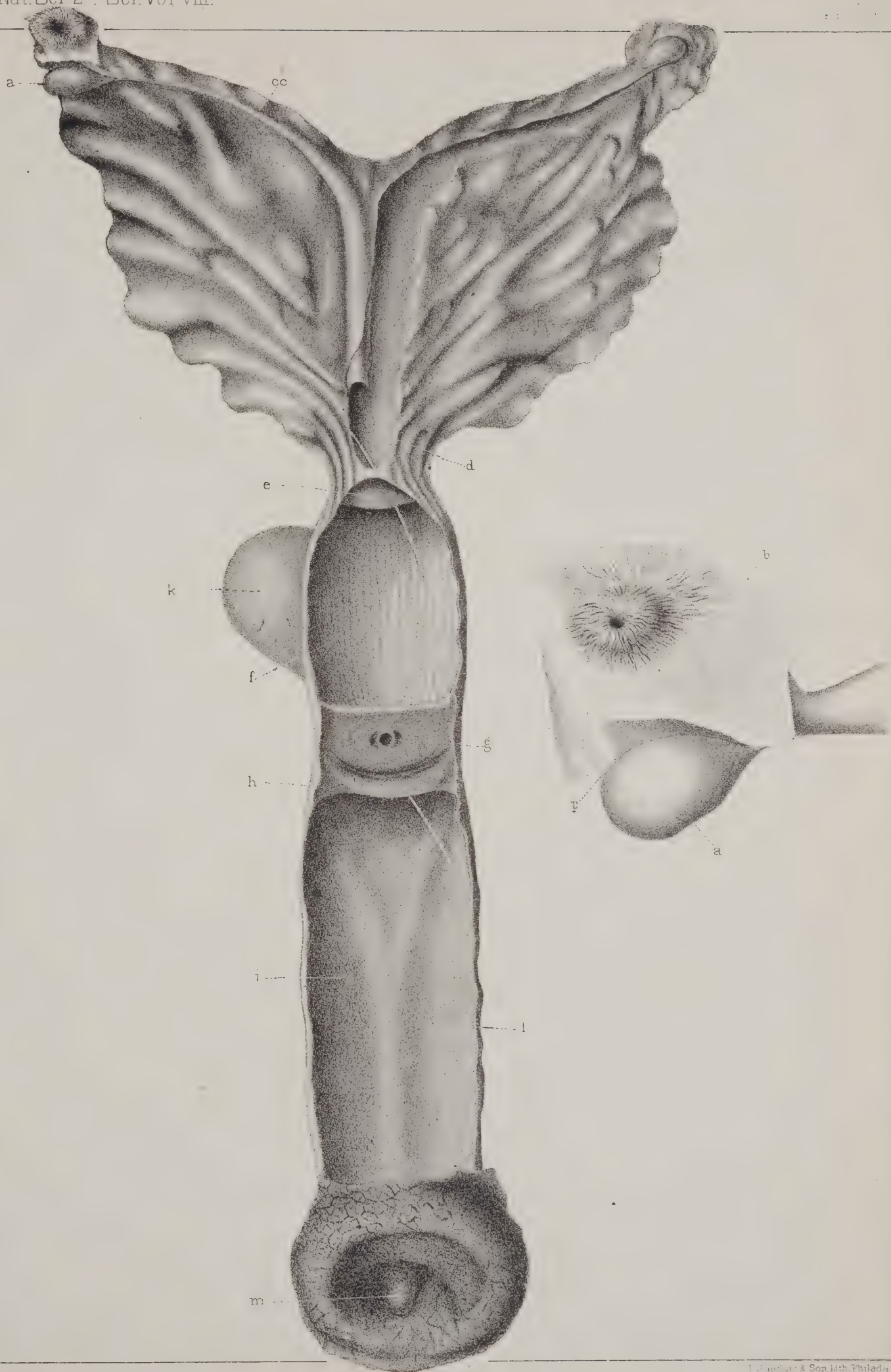


Chapman on Placenta of the Elephant.



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Chapman on Placenta of the Elephant.



Elephant. Genital Organs of Elephant





1-17 PYRSONYMPHA VERTENS. 18-26 DINENYMPHA GRACILIS. 27 GREGARINA TERMITIS
28-34 ARTHROMITUS CRISTATUS. 35 A. INTESTINALIS. 36-39 VIBRIO TERMITIS.

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